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6170.8

MAINT E NANCE OF DATA TERMINAL EQUIPMENT (DTE)



October 15, 1979

**DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION**

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FOREWORD

1. PURPOSE.

This order provides guidance and prescribes technical standards and tolerances and procedures applicable to the maintenance and inspection of data terminal equipment (DTE). It also provides information on special methods and techniques that will enable maintenance personnel to achieve optimum performance from the equipment. This information augments information available in other directives and complements Order 6000.15A, General Maintenance Handbook for Airway Facilities.

2. DISTRIBUTION.

This directive is distributed to selected offices and services within Washington headquarters, NAFEC, and the Aeronautical Center; to branch level within the regional Airway Facility divisions; and to Airway Facilities field offices having the following facilities/equipment: ARTCC, CFCCC, CERAP, ATCT, TRACO, FSSI, FSSA, AFSS, IFSS, RAPCO, RATCF, TTY, WMSC, BDIS, TTS, COMCO, IATSC, NADIN.

3. MAINTENANCE POLICY AND MODIFICATION POLICY.

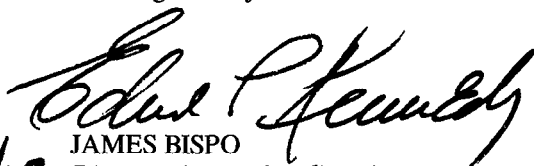
- * a. Order 6000.15A, this order, shall be consulted and used together by the maintenance technician in all duties

and activities for the maintenance of data terminal equipment. These documents shall be considered collectively as the single official source of maintenance policy and direction authorized by the Airway Facilities Service. *

b. Order 6032.1A, Modification to Ground Facilities, Systems, and Equipment in the National Airspace System, contains comprehensive policy and direction concerning the development, authorization, implementation, and recording of modifications to facilities, systems, and equipment in commissioned status. It supersedes all instructions published in earlier editions of maintenance technical directives and related directives.

* 4. CONFIGURATION MANAGEMENT.

This handbook is under configuration management control as defined in Order 1800.8E, National Airspace System Configuration Management, and NAS-MD-001, National Airspace System Configuration Management Document. Any changes to the baseline document or requests for deviation from national standards shall be processed through the national change proposal (NCP) process. Copies of FAA Form 1800-2, NAS Change Proposal, are provided in the back of this handbook for the convenience of handbook users. *


JAMES BISPO
for Director, Airway Facilities Service

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CHAPTER 1. GENERAL INFORMATION AND REQUIREMENTS

1. OBJECTIVE.

* This order provides the necessary guidance to be used in conjunction with information available in other orders and directives for the proper maintenance of * data terminal equipment (DTE).

2. SCOPE AND COVERAGE.

a. This order provides maintenance information and instructions for the type FA-9669 DTE set, which includes the following components:

- (1) FA-9669/1, terminal controller assembly
- (2) FA-9669/2, display monitor assembly
- (3) FA-9669/3, journal, write-only
- (4) FA-9669/4, journal, read/write
- (5) FA-9669/5, printer, friction feed
- (6) FA-9669/6, printer, tractor (sprocket) feed
- (7) FA-9669/7, numerical keypad assembly
- (8) FA-9669/8, keyboard assembly

NOTE: The printer, either friction or sprocket feed, is a model 40 80-column unit manufactured by Teletype Corporation, Skokie, Illinois.

b. The glossary of appendix 1 contains definitions of specialized telecommunication and other terms used in microprocessor and computer technology. Other appendixes contain reference data useful in operation, maintenance, and diagnostics of DTE sets. Figure 1-1 is a sketch showing DTE components cabled together for operation as a duplex (send-receive) terminal with two keyboard/displays and one numerical keypad.

3. TRADEMARK "TELETYPE."

"Teletype" is a registered trademark belonging to

the Teletype Corporation. "Teletype" shall be capitalized and always used as a company identification. Publications or correspondence originating within the agency pertaining to data-handling equipment will be referred to as "data-handling equipment," "teletype-writer" equipment, or by the individual unit name, such as "M40 printer."

4. COORDINATION.

a. Any maintenance operation or activity performed on the DTE that may affect normal operating procedures shall be coordinated with the user of the system, such as Air Traffic management or military operations personnel. Line relays may be removed only when the service equipment is disconnected from the line circuit or when the equipment is turned off.

b. Equipment removal, operations, or shutdown that may affect the long-line service shall be coordinated with the associated serving company or organization, such as the telephone company, Western Union Company, or the military services.

5. WAIVERS.

Where a region cannot comply with one or more of the standards and tolerances and/or procedures prescribed herein at a particular location, a request for a waiver shall be submitted as soon as practicable to the Airway Facilities Service. The request must fully describe the circumstances and contain justification for the waiver. Refer to Order 6000.20B, Waiver of Criteria for Establishment and Maintenance of Airway Facilities.

6. SERVING COMPANY LINE SERVICE.

All agency data-handling switching and system interconnections discussed in this order are designed for neutral or polar operation. Operation of the serving company's portion of the system is at their discretion. However, the extension from the FAA demarcation terminal is always required to be neutral, except at the RS-232 interface, which is a low level polar connection.

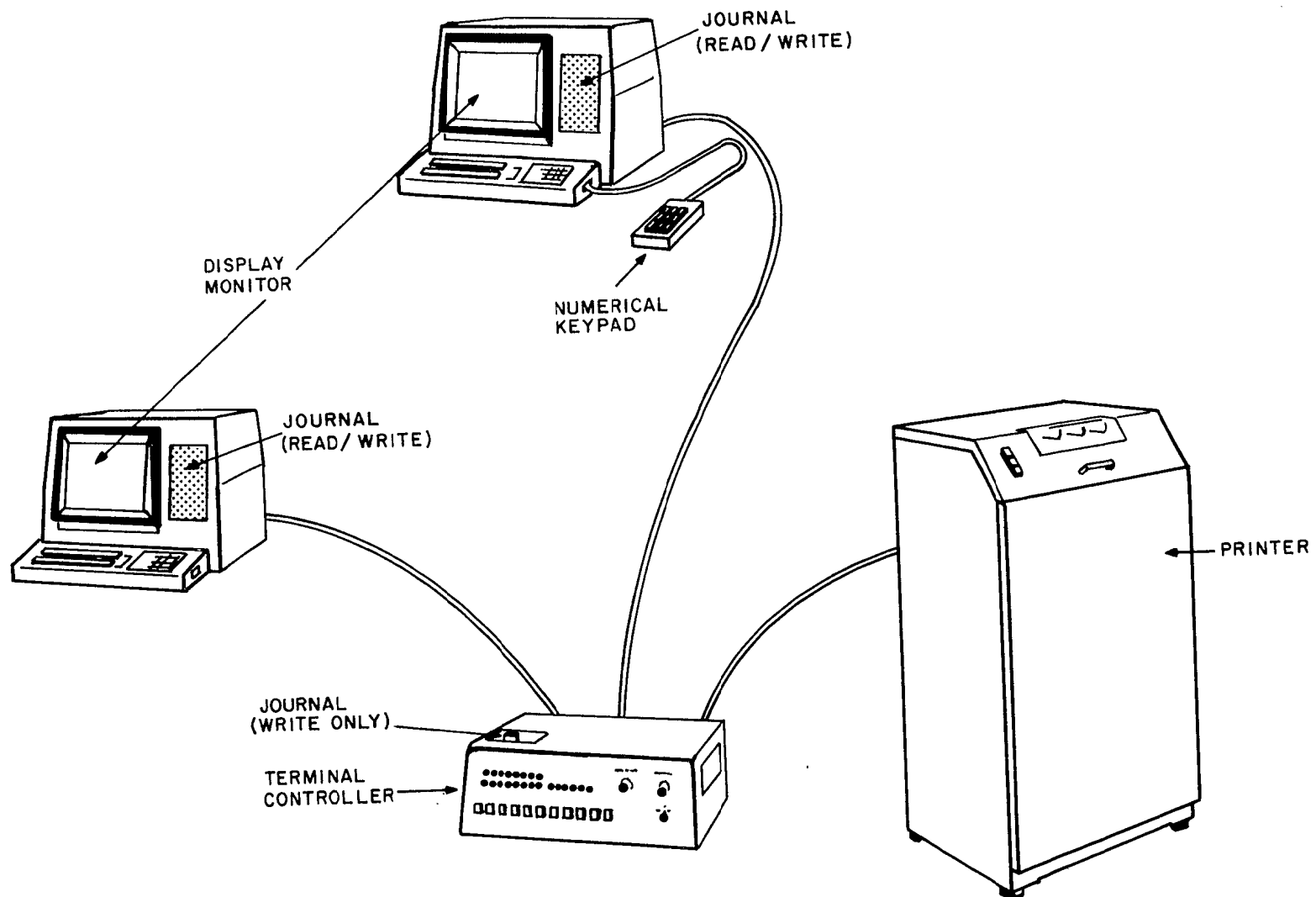


Figure 1-1. General View of a DTE Set

7. GROUND RULES.

The latest edition of Order 4441.9, Practices Concerning Leased Telecommunications Services, provides uniform guidelines covering the standardization and modernization of leased telecommunication services and serving companies. In quarters other than FAA, the ground rules apply only at the demarcation cabinet and to the installation on the equipment side of the demarcation strip.

8. EXTENSION OF LEASED SERVICES.

Some locations have two "drops" installed from one telephone company local channel. The additional extension had been wired in from the FAA demarcation strip by Airway Facilities personnel. American Telephone and Telegraph (A.T. & T.) has notified the Airway Facilities Service that while tariff imposes no limitation on the number of customer-owned-and-maintained (COAM) machines connected to a circuit at one location, it does provide that any extension of a circuit to a separate location must be installed by the telephone company. Some serving companies are providing a replacement solid-state power supply, which will limit the number of COAM machines to one or two.

9. CERTIFICATION REQUIREMENTS.

There are no certification requirements for data terminal equipment.

10. SERVICE INTERRUPTIONS.

Service interruptions of less than 1 minute ordinarily will not be reported to the serving company's serving test center (STC) unless the interruption occurs several times during an 8-hour watch. Garbling, line running open, or similar interruptions, which occur frequently or continue for longer than 1 minute should be reported to the serving company's STC. Operating personnel should be reasonably certain that the trouble is not due to malfunctioning of FAA equipment before notifying the serving company.

11. REPORTING EXCESSIVE LINE DISTORTION.

The acceptable distortion level received from the long lines can vary from 15 to 20 percent according to facility and serving company. When it is determined that the line has exceeded this mutually accepted level it is the responsibility of the Airway Facilities sector manager or his representative to notify the serving company.

12. MAINTENANCE CONCEPT.

The maintenance concept includes the general principles and procedures governing periodic maintenance, corrective maintenance, and diagnostic maintenance based on equipment specifications, contractual requirements, and agency policy.

a. The data terminal equipment (DTE) consists of four major components: the terminal controller, the keyboard/display, the printer, and the journal. These components are used in the basic configurations: send/receive terminal consisting of all units; receive-only terminal consisting of only the controller and printer; and send/receive terminal consisting of the controller, printer, journal, and from two to four keyboard/displays.

b. Training on DTE components is provided at the FAA Academy.

c. Upon equipment failure, spare equipment will be substituted by patching or switching, except for the keyboard/displays or journals. Facilities are provided with redundant equipment to effect substitutions when required. Facility electronics technicians localize trouble to the printed-circuit board (pcb) level and replace or substitute cards as required. Failed cards are repaired locally or are returned to the FAA Depot for repair and return (R&R) transactions. The latest edition of Order 6000.18, Field Repair of Equipment, contains policy affecting the management of field repair. If warranties are still in effect, do not attempt to repair components as this will void the warranty.

13-19. RESERVED.

CHAPTER 2. TECHNICAL CHARACTERISTICS

20. PURPOSE OR FUNCTION.

Data terminal equipment (DTE) is used in a variety of data communication systems for flight planning, col-

lection and dissemination of meteorological data, and coordination of air traffic movement. Figure 2-1 shows the basic configuration of the DTE.

Section 1. SYSTEM APPLICATIONS

21. GENERAL.

a. Primarily, the DTE replaces the model 28 (M28) automatic send-receive (ASR) teletypewriter sets used in the major networks of FAA data communications. The majority of DTE sets are allocated to high activity flight service stations (FSS's). In the future others will be allocated to air route traffic control centers (ART-CC's) and regional and headquarters message centers.

b. DTE terminals give users the capability to transmit and receive messages from a keyboard/display. It allows composition and editing on a keyboard/display with scratch-pad cassette storage available for holding unfinished messages or forms data. All incoming and outgoing traffic is recorded on a separate write-only cassette journal. When desired, hard copy is available from medium-speed line printers. The type-nomenclature modules of the DTE are:

- (1) Terminal Controller, FA-9669/1
- (2) Display Monitor, FA-9669/2
- (3) Write-Only Journal, FA-9669/3 (integral part of all terminal controllers)
- (4) Read/Write Journal, FA-9669/4 (optional, part of certain display monitors)
- (5) Friction-Feed M-40 Printer, FA-9669/5
- (6) Tractor-Feed M-40 Printer, FA-9669/6
- (7) Keypad Assembly, FA-9669/7
- (8) Keyboard Assembly, FA-9669/8

c. The modules are arranged in different configurations to suit the needs of the user. The simplest configuration is a controller and printer in a receive-only operation. More complex facilities involve up to 3 terminal controllers, 4 to 12 keyboard/display monitors, and 2 to 6 printers. Up to four keyboard/display monitors and two printers can be used with each terminal controller. Each keyboard and keypad combination must be associated with a display monitor. The read/write journal is a scratch-pad cassette, magnetic-tape journal mounted in the display monitor on an optional basis. The write-only journal is an historical cassette, magnetic-tape journal mounted in all terminal controllers to record all incoming and outgoing messages. (The basic DTE configuration is shown in figure 2-1.)

22. SERVICE B.

Service B provides record communications among all FAA operating facilities, headquarters, and regions as well as associated aviation users. It consists of two transcontinental networks: a major network known as area B, or alternatively, automated service B data interchange system (A-BDIS), and a minor network called center B. In addition, there is a set of circuits referred to as utility B, for high volume users, military and air carriers. Although computer B is a part of service B, it is actually a subsystem of the National Airspace System (NAS) stage A en route system (IBM 9020). It is a hybrid composed of the flight data entry and printout (FDEP) equipment and flight data distribution system (FDDS) servicing the towers and instrument flight rules (IFR) rooms. Service B was implemented to expedite the transfer of flight planning, movement and notification information, and aviation and air traffic control supporting information.

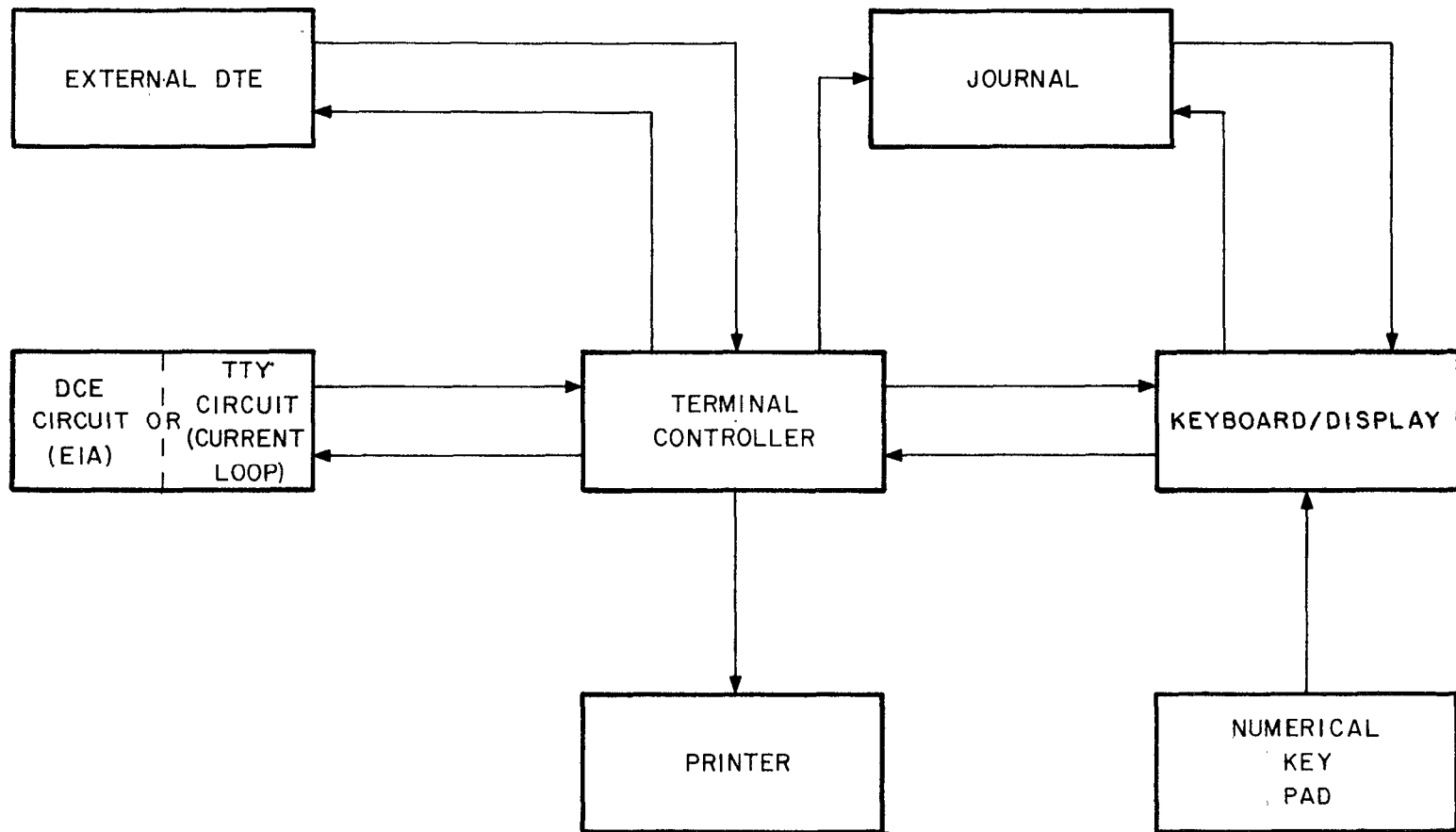


Figure 2-1. Basic DTE Configuration Block Diagram

a. **Area B.** Area B network consists primarily of 75-baud channels used for the distribution and collection of data from terminals at flight service stations (FSS's), combined stations and towers (CST's), and air route traffic control centers (ARTCC's). Automatic relay of the message is provided by computers located at the National Communications Center (NATCOM) and the Kansas City ARTCC. Relay is also made to the Aeronautical Fixed Telecommunications Network (AFTN). The A-BDIS computers are connected to AFTN via a 2400-bit per second (b/s) link. Other medium-speed links extend to the Meteorological and Aeronautical Presentation Subsystem (MAPS) at Washington FSS (collocated with Washington ARTCC) and to the Automated Weather and NOTAM System (AWANS) at Atlanta, Georgia, and Indianapolis, Indiana.

b. **Center B.** The center B system is an intercontinental network interconnecting all ARTCC's. The ARTCC's are connected to the AFTN switch at Kansas City via five separate circuits. The AFTN switch provides the polling and interfacing necessary to the ARTCC communication with AFTN circuits and for area B circuits (BDIS).

c. **Utility B.** The utility system is a combination of those independent circuits formerly called military B and carrier B. It is used to transfer military and commercial carrier IFR flight plans to the center responsible for the area in which the flight originates. There are two different categories of utility B. Category 1 consists of send/ receive circuits, polled by automatic program unit-low speed (APULS) with no relay capability between circuits; while category 2 consists of one-way, unpolled point-to-point circuits from base operations and airline dispatch offices.

23. SERVICE A AND WEATHER COMMUNICATIONS.

a. The weather teletypewriter communications system (WTCS) is designed to centralize, consolidate, and automate the message switching functions of the three message services A, C, and O through a weather message switching center (WMSC) at Kansas City, Missouri. The circuit control and relay functions of the WMSC are performed automatically by a Phillips DS-714 message/data switching system, which is a computer-directed, store-and-forward communications switch. Its function is to perform all polling, collection,

storage, selection, and re-distribution of the meteorological and notices to airmen (NOTAMS) information handled by the consolidated system.

b. The DS-714 system has a variety of transmission speeds. It will interface with a range from 100 words per minute (wpm) teletypewriter circuits to 9600 bits per second data circuits. Currently, the circuits having 2400 bits per second are the fastest in use. It also accepts information in Baudot or American Standard Code for Information Interchange (ASCII) codes at any standard teletypewriter or data interface level.

24. AERONAUTICAL FIXED TELECOMMUNICATIONS NETWORK (AFTN).

a. The present FAA-AFTN network is divided into the North Atlantic and Caribbean, Alaskan, and Pacific Areas. All are served by a fully automatic computerized facility at Kansas City which utilized a Phillips DS-714. In addition, a Phillips ES-3 is currently used to support the Alaskan area. The ES-3 is now located in Anchorage, however, plans call for its decommissioning at which time all Alaskan circuitry will be extended to the Kansas City facility.

b. In 1970, FAA replaced the manual switching centers associated with the North Atlantic and Caribbean Area by an automated central distribution center at Kansas City, Missouri. It is collocated with the WMSC and BDIS relay facilities at the National Communications Center (NATCOM). The AFTN center is referred to as the International Aeronautical Telecommunications Switching Center (IATSC). Its function is the relay of international meteorological and aeronautical traffic, which was originally performed at New York, Miami, San Juan, and Balboa. These locations now serve as hubs to feed the IATSC.

25. NATIONAL AIRSPACE DATA INTERCHANGE NETWORK (NADIN) AND MESSAGE CENTERS.

a. A national digital communication network to absorb the services and networks described in paragraphs 22 through 24 is programmed. The proposed network is to be controlled by two major switching centers, one at Atlanta and the other at Salt Lake City, adjacent to the air route traffic control centers (ARTCC). The major centers will handle a network of "concentra-

tors," located at each ARTCC. The centers will feed both dedicated and multipoint data-handling circuits in the continental United States (CONUS), and separate tributary circuits to Honolulu, Anchorage, and San Juan.

b. The data-handling rates between the switching centers and concentrators is to be 2400/4800 synchronous bits per second. Between the two switching centers, the data rate is to be 9600 synchronous bits per second. Local circuits handled by the concentrators, such as area B, AFTN, utility B, and the like will range from 50 to 1200 baud, asynchronous. The ARTCC concentrator will interface with the local en route 9020 computer system at 9600 bits per second, asynchronous serial. The three communication codes to be used are the extended binary coded decimal for information code (EBCDIC) between the 9020 and the concentrator, the ASCII on the weather message circuits, and the Baudot teletypewriter code on AFTN, area B, utility B, and similar circuits.

26. DTE

The initial procurement of DTE will be utilized primarily at the higher activity flight service stations. However, as funds become available, plans call for the replacement of all old and obsolete teletypewriter equipments. The DTE can be used in conjunction with existing and planned FAA circuitry. Due to the impact on other systems, it is expected that DTE application will necessarily be a gradual phase in. Since Service A terminals are currently leased from Western Union, DTE use will be limited initially to Service B and other

circuits. The DTE will be used at high activity flight service stations to support the first phase of the FSS Automation Program. Initial application of DTE on Service B will be at 75 baud. Figure 2-2 reflects a hypothetical DTE configuration for a flight service station.

27. OPERATIONAL MODES.

The basic DTE system (figure 2-1) is operated in any of the modes described below. The signal line is either a data communications equipment (DCE) line or teletypewriter (tty) line. Data paths among the basic DTE elements are shown in figure 2-1.

a. **DCE Interface.** The DCE interface connects the DTE to the Electronic Industries Association (EIA) RS-232 line. This is voltage line signaling at a low level. In this interface, the DTE is capable of operating with data exchange circuits that conform to the American National Standards Institute (ANSI) modes, with the weather message switching center (WMSC mode), or with both types of circuits.

(1) **ANSI Mode.** In ANSI mode, all message transfers (reception and transmission) are initiated by the external circuit and are performed in accordance with circuit mode of operation (ANSI A2, ANSI A4, or ANSI B1) and baud rate selected with the terminal controller front panel controls. (Table 2-1 lists the baud rates versus units per character and the DCE circuit types.) However, the circuit mode of operation may also be selected by a command from the external circuit (downline) if the terminal controller polling selector is set to automatic. All messages can be error controlled.

Table 2-1. AVAILABLE DCE BAUD RATES

<i>Terminal Controller BAUD RATE Switch Setting</i>	<i>Speed (Baud)</i>	<i>Units per Character</i>	<i>ANSI Mode</i>
150	150	10	Asynchronous (or WMSCMSF2)
300	300	10	Asynchronous
600	600	10	Asynchronous
1200	1200	10	Asynchronous (or WMSCMSF2)
SYNCH	1200	8	Synchronous

Table 2-1. AVAILABLE DCE BAUD RATES (Cont'd)

<i>Terminal Controller BAUD RATE Switch Setting</i>	<i>Speed (Baud)</i>	<i>Units per Character</i>	<i>ANSI Mode</i>
SYNCH	2400	8	Synchronous (or WMSCMSF3)
SYNCH	4800	8	Synchronous
SYNCH	9600	8	Synchronous

(2) **WMSC Mode.** In WMSC mode, three formats are available: WMSC (synchronous multipoint message transfers at 2400 and 4800 baud with error control); WMSCMSF3 (synchronous point-to-point message transfers at 2400 baud with error controls); and WMSCMSF2 (asynchronous broadcast message transfers at 150 and 1200 baud without error control). The DTE receives and transmits the message in the format and speed selected by means of the terminal controller front panel controls. There are no plans to use the "WMSC" mode of operation. These modes may be deleted in future revisions of DTE firmware.

b. **TTY INTERFACE.** When the DTE is interfaced with a TTY signal line, one of three operational modes is possible: one-way (receive-only); half-duplex (receive

and transmit nonsimultaneously); or duplex (receive and transmit simultaneously--sometimes referred to as "full-duplex operation"). The mode is determined by strapping procedures during equipment installation or subsequent modification and is not an operator option. All message transfers in both directions take place at 75 baud; DTE ASCII codes are automatically converted to the five-level Baudot (ITA-2 category) code before transmission over the tty signal line. The DTE may send to, and receive from, a model 28 teletypewriter set. The ASCII and ITA-2 Baudot codes are fully described in the latest edition of Order 6170.6, Maintenance of Data-Handling Terminal Equipment (Teletypewriter). The DTE operates in half-duplex mode in conjunction with low speed service B.

28-29. RESERVED.

Section 2. EQUIPMENT DESCRIPTION

30. GENERAL.

The elements of the DTE set are briefly described in the following subparagraphs. Functional theory of the logic circuits is located in section 3.

31. TERMINAL CONTROLLER, FA-9669/1.

The terminal controller provides an interface between the communication circuits, keyboard/display monitor, printers, and journal. The controller offers a flexibility that allows access to data communication circuits from a single keyboard/display monitor. An operator has the capability to communicate with stations, for example, on either service A or service B network, other keyboard/display monitors associated with the same controller, or keyboard/display monitors

associated with another interconnected collocated controller at the same facility.

a. The controller is compatible with existing and future FAA systems that include the American National Standards Institute (ANSI X3.28), Procedures for the Use of Communication Control Characters of ASCII in Data Links. The controller operates over an RS-232 low-level voltage data interface or a 75-baud, 60-or 20-milliampere teletypewriter interface. The RS-232 interface operates either asynchronously from 75 to 1200 baud or synchronously from 1200 to 9600 baud. The controller is composed of four major subassemblies; front panel, logic board, write-only journal, and power supply.

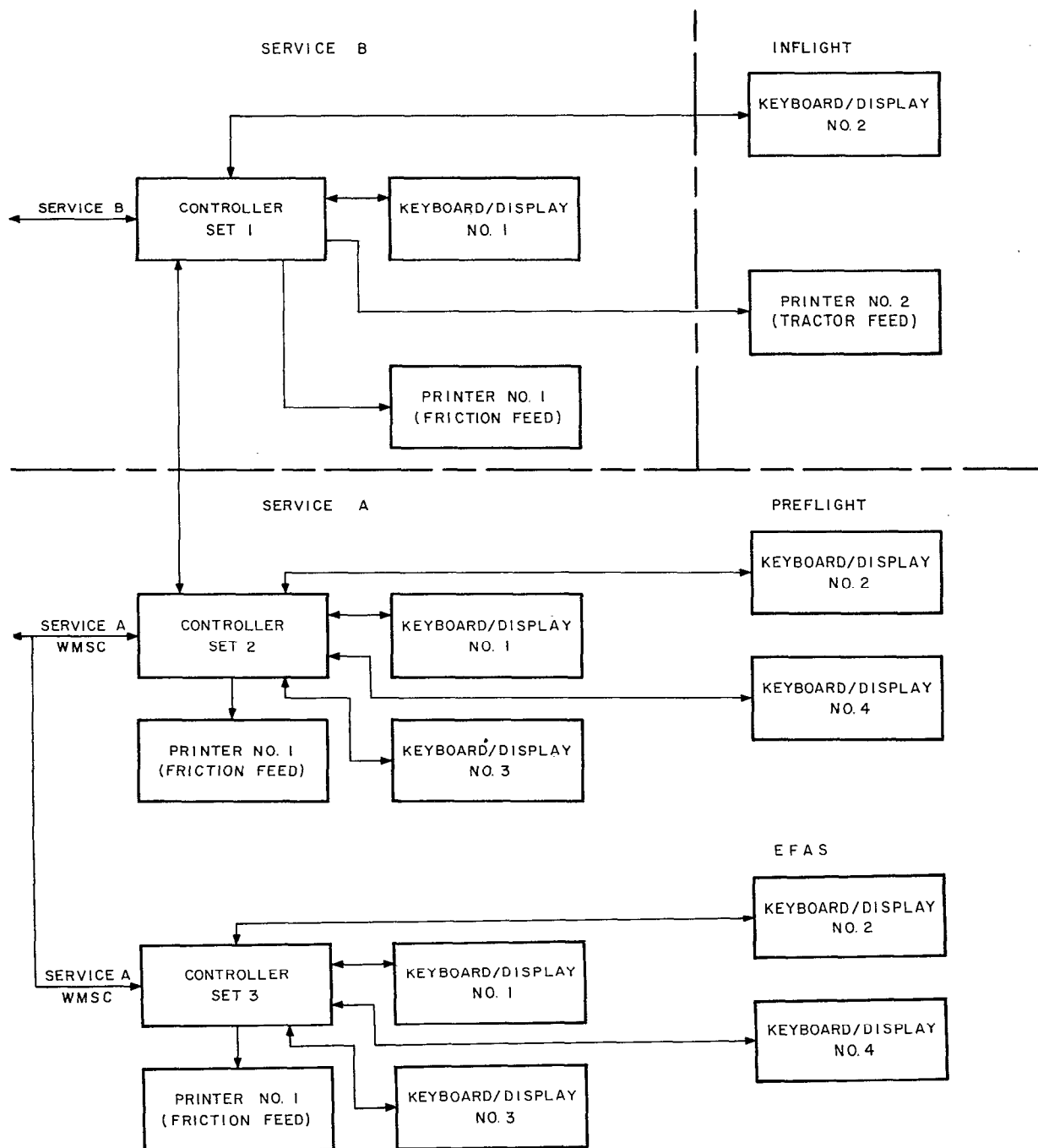


Figure 2-2. DTE Configuration at an FSS

b. The front panel allows operator selection of mode, reconfiguration, and format. Line break, low tape, buffer--80-percent full, and parity error indications provide terminal status to the operator. From the format selector, it is possible to select one of three ANSI or one of three WMSC programed transmission formats.

c. The controller logic board assembly is made up of microprocessor electronics providing programmable message formats and acknowledgements, automatic re-configuration from downline command sequence, store and forward buffering to and from communications lines, keyboard/displays and printers, code conversion, and programmable polling sequences. The keyboard-/displays interface is a 9600-baud, 12-volt RS-232 standard interface. The printer uses a special serial high-speed interface developed by Teletype Corporation, Standard Serial Interface (SSI). (Refer to paragraph 2-7.) The communication line interface operates simplex, half duplex, or full duplex with the DCE at speeds from 75 to 9600 baud in accordance with EIA RS-232 specifications, utilizing the ASCII code. Both synchronous and asynchronous modes are possible.

d. Each terminal controller has a write-only historical journal. The journal is a cassette tape transport, which records all incoming and outgoing messages. Since it is a write-only recorder, playback is accomplished by transferring the cassette to the read/write journal of the keyboard/display monitor. The tape has a maximum capacity of 2.88 megabits. This based on * 300 ft. of tape continuously recorded at 800 bits per * inch. Due to the time used to start and reach operating speed, as well as the tape used during stopping, a lower capacity will be experienced. Approximately 0.65 inches of tape is used by the start/stop process. Consequently, the amount of data that can be stored is proportional to the length and number of messages recorded. When the tape is from 95 to 99 percent exhausted, an alarm lamp lights and an audible alarm sounds. This condition inhibits line traffic flow until the cassette is replaced. The tapes have a timing track for motor speed control and, therefore, ARE NOT TO BE BULK ERASED.

32. KEYBOARD/DISPLAY MONITOR, FA-9669/8 and FA-9669/2.

The keyboard/display monitor consists of a 12-inch cathode-ray tube (crt) display with an optional read/write journal, keyboard, and an optional numeric keypad. The display is a 12-inch (30.5 cm) green phosphor crt. It has 24 write lines with 80 character positions per line. The character matrix is nine dots high and seven dots wide. Using the keyboard messages, the specialists can compose and edit on the display. Two pages of memory are available. Editing capabilities consist of page scrolling, and character or line insertion and deletion features.

33. PRINTERS, FA-9669/5 and FA-9669/6.

The printer produces a hard-copy printout. Selection of the printer operating configuration is made by using a front-panel switch (PRINTER/CRT) on the terminal controller, which causes only messages from the lines to go to the printer. Messages can also be directed to the printer from local keyboard/display units via special entry. (The printer mode switch has no control of messages initiated from local keyboard/display.) Two types of Teletype Corporation model 40 receive-only (RO) printers are used in the DTE. One is the friction-feed paper type and the other is a tractor (sprocket) feed paper type. Both types of printers print 80 characters per line at speeds up to 5.2 lines per second. The friction-feed printer accommodates multicopy friction-feed paper, 8-1/2 inches (21.6 cm) wide on a 5-inch (12.7 cm) diameter teletypewriter roll. The sprocket-feed printer accommodates multicopy sprocket feed paper, 9-inches (22.9 cm) between sprocket holes with an 8 1/2-inch (21.6 cm) wide printing field.

34. JOURNAL, FA-9669/3 and FA-9669/4.

The journal consists of two digital cassette-type magnetic-tape transport stations: write only (record) and read/write (playback/record). These two stations are MFE Corporation, digital, cassette-tape transports model 250B (read/write) and model 250BW (write only). The read/write station, interfaced with the keyboard/display, is used for form storage and scratch-pad operation. The write-only station, interfaced with the terminal controller, is used to record a history of data transmitted to, and received from, the communication lines (tty) and the DCE (EIA).

35. NUMERICAL KEYPAD, FA-9669/7.

The numerical keypad consists of 12 key switches and a key matrix. It permits numerical data to be sent via the keyboard interface logic circuit to the central processing unit (CPU) in the keyboard/display monitor when there is no operator using the main keyboard. The keypad keys produce the corresponding ASCII code for the numeral or symbol keyed. The asterisk (*) key produces no code and has no function. The pound (#) key produces an ASCII code for the line send function and is equivalent to D4 control function on main keyboard.

36. TEST AND INTERFACE CABINET.

The test and interface cabinet houses up to three terminal controllers on sliding cradle assemblies that allow easy-access servicing. An EIA patch panel is included, which provides line/equipment/monitor patching of the controller-to-crt, controller-to-DCE, and controller-to-DTE interfaces. A breakout test panel permits monitoring either the DTE or DCE channel on an individual line basis (up to 12 lines per channel). Besides monitoring, the lines can be set high or low with a solid level in testing for proper responses. Also included is a pulse trap that will indicate the presence of a 3-microsecond pulse on the line selected. The test and interface cabinet also provides patching for the printer circuitry. Jacks for the printers are not com-

patible with the EIA jacks. This was done to preclude the possibility of a mismatch that would result in damages.

a. The EIA patch panel is made up of a 3-barrel, 12-line jack field. It is divided in three groups (one per each controller). A line/equipment/monitor jack arrangement is provided for each crt (one to four), DCE trunk, and DTE trunk. The jack is a special insert and lock, 12-circuit jack that permits up to 12 signal and control lines associated with a channel to be patched in one operation. There is also a two-barrel jack field provided for line/equipment patching of the two printer positions of each controller.

b. Either the DCE or DTE trunk circuits can be patched from the EIA patch panel to the breakout test panel and monitored via a light-emitting diode (LED) display for each signal or control line. Test points are also available to tie any line to a ± 12 -volt direct-current level. From the pulse trap it is possible to monitor any of the lines and present a positive indication of any line condition of 3 microseconds or more duration.

37. SUMMARY OF TECHNICAL CHARACTERISTICS.

The characteristics of the DTE, listed in terms of its principal components, are contained in table 2-2.

Table 2-2. SUMMARY OF TECHNICAL CHARACTERISTICS

TERMINAL CONTROLLER

Communication operating modes (front panel selectable)	Receive all Receive select/crt Receive select/printer Weather message send Tty line message send
Data Transfer.....	Line to monitor Line to printer Line to other controller Monitor to other controller Monitor to line Monitor to journal

KEYBOARD/DISPLAY

Screen Size.....	12-inch diagonal, 63-in ² display area
Display.....	P42 phosphor
Characters per line.....	80

Lines per display	24
Capacity	1920 characters
Character set	128 ASCII
Character format	7 by 9 dot matrix
Refresh rate	50Hz
Cursor	Blinking block with inverse video
Repetitive key-activated functions	50 per second (maximum)
Input/output data rate	More than 9600 bits per second

JOURNAL

Operating mode	Continuous
Operating speed	80 inches per second
Recording format	Biphase level
Recording density	800 bits per inch

PRINTER

Paper handling	Friction or sprocket (tractor) feed
Operating speed	150 characters per second, minimum
Printout	Full 128 ASCII character code plus error symbol

POWER CAPABILITY

Power supply output (terminal controller or keyboard display)	+5V dc at 8A maximum -5V dc at 1A maximum +12V dc at 1A maximum -12V dc at 0.5A maximum
Terminal controller power input	102 to 138V ac, 57 to 63Hz
Keyboard/display power input	102 to 138V ac, 57 to 63Hz
Printer power input (friction or sprocket feed)	103.5 to 126.5V ac, 59.5 to 60.5Hz

Journal power input (write only or read/write)..... +4.75 to +5.25V dc at 700mA; -4.75 to -5.25V dc at 500mA

INTERFACE

Teletypewriter (tty).....	Receive only, half duplex, full duplex with circuit configurations of 60mA neutral, 20mA neutral, and 20mA polar
Data communication equipment (DCE).....	150, 300, 600, 1200, 2400, 4800, and 9600 baud transmission reception rate asynchronous and line-controlled synchronous

38.-39. RESERVED

Section 3. THEORY OF OPERATION

40. GENERAL.

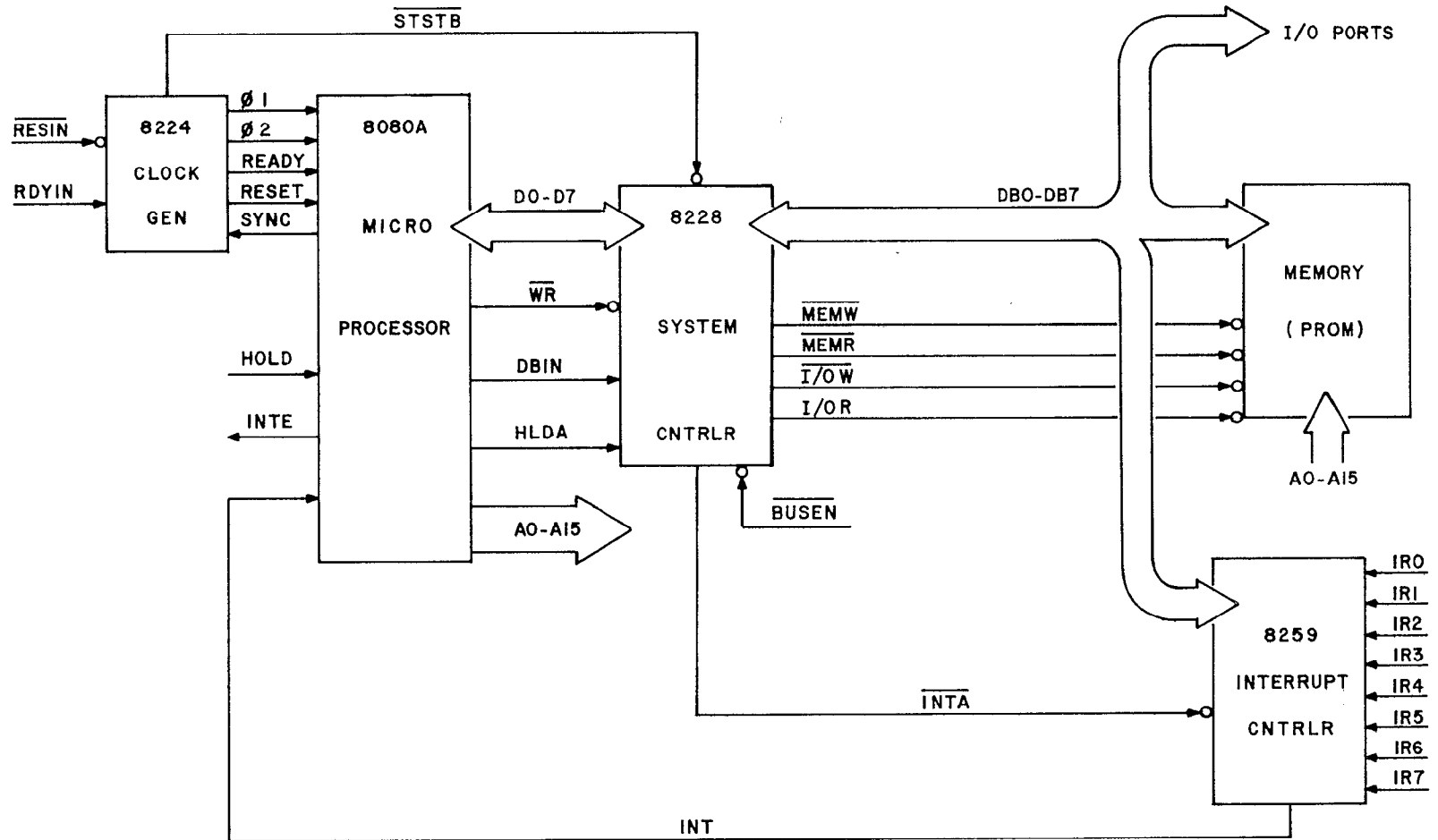
Because the DTE is one of the first major applications of microprocessor-controlled equipment, a simplified discussion of the type 8080A microprocessor system is provided. The intent is not to provide a detailed discussion of the 8080A, which is used in the terminal controller and in the keyboard/display, but to introduce a method in which the microprocessor operates and to tie that to its operation in the DTE components. For specific operational details, refer to the type FA-9669 instruction book.

41. MICROCOMPUTER TYPE 8080A OPERATION.

An 8080A microcomputer comprises five major elements: clock, microprocessor, system controller, interrupt controller, memory element (RAM, ROM, ERROM), and input-output (i/o) ports. See figure 2-3. The usage of the interrupt controller depends upon the type of interrupt-handling technique used (vectored, single-line, or multilevel).

a. The 8080A microprocessor is the heart of the microcomputer. Separate microprocessors are provided for the terminal controller and keyboard/display units. It provides the necessary large-scale integration (LSI) hardware to fetch and execute a program stored in a separate storage element. The program is composed of a sequential set of instructions, which the microprocessor fetches and executes. The instruction can be from one to three bytes of data. The first byte is the operation

code that defines the operation to be executed; i.e., move word, jump, add registers, etc. The type of instruction will determine the number of bytes fetched for execution. See appendix 3 for an 8080A instruction set. The microprocessor operates at a clock frequency one-ninth of the crystal frequency of the 8224 clock generator. The 8224 clock provides the microprocessor with two phase-related clocks, $\phi 1$ and $\phi 2$. The $\phi 2$ clock pulse is longer and is delayed at the same frequency of $\phi 1$. The microprocessor returns a SYNC signal to the clock generator to identify the beginning of a processor machine cycle. A machine cycle is 3 to 5 state times ($\phi 1$ clock periods) required to accomplish a fetch, memory read/write (R/W) or I/O R/W operation. An instruction cycle can contain several machine cycles. At time T1 of each machine cycle, the $\phi 1$ clock generator and the SYNC are both high to develop the status strobe (\overline{STSTB}). The \overline{STSTB} is a latching pulse that saves the status word in the 8228 system controller during each machine cycle. The status word is 8 bits active on the microprocessor data bus at the beginning of the machine cycle. A \overline{STSTB} timing diagram is shown in figure 2-4. See table 2-3 for status bit identification. The major function of the system controller is to control the destination of the data on the data bus for each machine cycle. This is accomplished by the not-write (\overline{WR}) and the data-bus-in (DBIN) signals from the microprocessor in conjunction with the status bits stored in the status latch of the system controller. When the \overline{WR} is active (low), data is being transferred from the microprocessor to either memory or an i/o



BASIC 8080A MICROCOMPUTER

Figure 2-3. Microcomputer Type 8020A Functional Diagram

device (write operation--output). When DBIN is active (high), data is being transferred from memory or i/o to the microprocessor (read operation--input). During the write or output operation, the \overline{WR} identifies the destination by enabling the \overline{MEMW} or $\overline{I/OW}$. Only one will be enabled, as determined by the status bit that is

active. The \overline{MEMW} or $\overline{I/OW}$ becomes the function enable operation to transfer data to the associated chip, memory, or i/o, respectively. Similarly, the \overline{MEMR} and $\overline{I/OR}$ are activated for the read and input operation.

Table 2-3. STATUS BIT IDENTIFICATION

STATUS SYMBOLS	DATA BUS BIT	DEFINITION
HLTA	D3	Acknowledge signal for halt instruction.
INTA	D0	Acknowledge signal for INTERRUPT request. Signal should be used to gate a restart instruction onto the data bus when DBIN is active.
INP	D6	Indicates that the address bus contains the address of an input device and the input device should be placed on the data bus when DBIN is active.
OUT	D4	Indicates that the address bus contains the address of an output device and the data bus will contain the output data when the \overline{WR} is active.
MEMR	D7	Designates that the data bus will be used for memory read data.
M1	D5	Provides a signal to indicate that the CPU is in the fetch cycle for the first byte of an instruction.
STACK	D2	Indicates that the address bus holds the pushdown stack address from the stack pointer.
WO	D1	Indicates that the operation in the current machine cycle will be a WRITE memory or OUTPUT function ($\overline{WO}=0$). Otherwise a READ memory, INPUT operation, or interrupt or halt acknowledge will be executed.

b. The 8080A microprocessor can be stopped by one of several methods: the READY line to the processor goes low or the processor executes a HALT instruction. The READY line is enabled by the clock generator whenever the RDYIN signal is inactive. RDYIN inputs can originate from the i/o RAM or PROM chips to indicate that the peripheral equipment is ready to transfer data. The RDYIN serves as a wait request for the processor to allow for a delay in i/o and memory operations. The HALT instruction encountered in the program will also cause the processor to enter the halt state. The halt state can only be executed by reset input (\overline{RESIN}), which returns the processor to state T1 and clears the program counter. Or

the HOLD input causes the processor to enter the hold state. When the HOLD input drops, the processor will return to the halt state on the next $\phi 1$ clock pulse. If the interrupt enable (INTE) flag is set and an interrupt (INT) is received, the halt loop will be exited. The INTE flag can only be set and reset by a program instruction. The HOLD input is used to disable the processor by an external source, allowing the address and data buses to become available for direct memory access. The HLDA (hold acknowledge) floats the data and address to allow control by the external device.

c. The vectored interrupt system uses the 8259 programmable interrupt controller. The vectored sys-

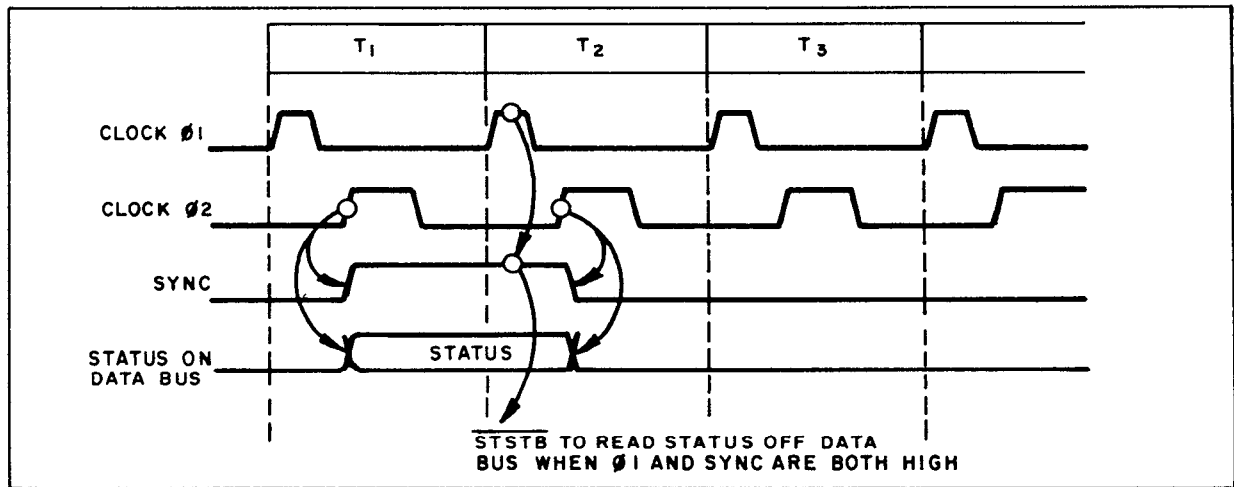


Figure 2-4. Status Strobe (STSTB) Initiation

tem is one in which an interrupt request by a device wanting service directly branches the program to a subroutine designed to service that device. The controller determines the priority of up to 8 individual interrupt requests, with a capability of up to 64 interrupt requests. During the initialization routine, the program writes in an interrupt mask to determine which interrupt requests are going to be recognized. Upon reception of an interrupt request, the interrupt controller issues an INT signal to the CPU. The CPU responds with three interrupt acknowledge ($\overline{\text{INTA}}$) pulses from the system controller. The first $\overline{\text{INTA}}$ gates a CALL instruction code (CO) to the CPU. The second and third $\overline{\text{INTA}}$'s gate a byte each of the address in the jump table that contains the address of the interrupt service routine.

42. KEYBOARD/DISPLAY MONITOR OPERATION.

The keyboard/display monitor logic is contained on a single large printed-circuit board (pcb). See figure 2-5. The logic is microprocessor controlled in a manner similar to that described by the 8080A discussion (paragraph 41). The logic is divided into seven major elements: microprocessor (CPU), program and scratch pad memory, video memory, crt and video logic, read/write journal interface, signal input/output (SIO) interface, and keyboard interface.

a. **Microcomputer (CPU).** The display monitor central processing unit is the same as that discussed under

basic microcomputer operation, with the addition of the DM8097 tristate address buffers and a 74LS138D i/o decoder. The tristate address buffers isolate the address lines from the 8080A to the external address bus servicing the peripherals. Being tristate, the microprocessor address bus can be isolated from the external address bus during DMA operation by enabling the HOLD signal, which in turn enables the HLDA during the hold cycle. The address decoder decodes address bits to enable the i/o select pulses to the peripheral i/o ports (video RAM, keyboard, read/write tape, and SIO).

b. **Program and Scratch-Pad Memory.** The program storage for the keyboard/display is 4K of PROM memory. It is contained on two 2K chips with sockets available to accommodate expansion to 4K additional memory. Each PROM is 2K by 8 bits with address locations 0000H through IFFFFH. (See figure 2-6.) The ROM chip select decodes address bits A12 and A13 to select the lower or upper 2K chip. Address bits A0 through A10 are decoded by the PROM to address the proper byte within the 2K (7FFH) addresses selected. The scratch-pad storage is 256 (IFFH) bytes of RAM memory. One-half of a byte of each word is stored in each 9111 RAM. Since the address of the scratch pad ranges from 2000H to 20FFH, address bits A0 to A7 define the address of 256 bytes while A15=0, A14=0, and A13=1 provide the chip enables for the RAM. Bidirectional buffers control the data flow to and from the storage data bus. The tristate buffers require no

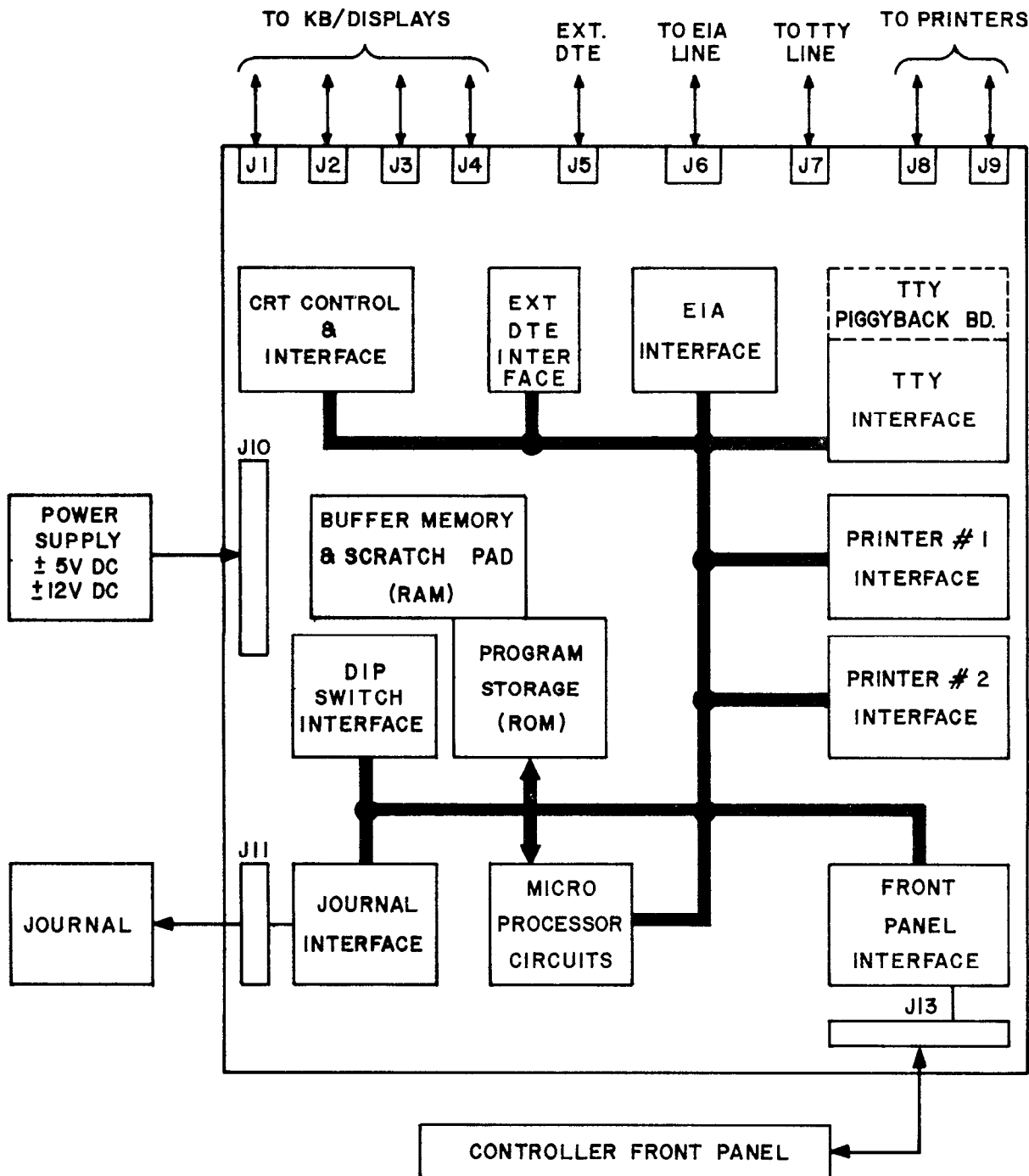


Figure 2-5. Keyboard/Display Monitor Functional Diagram

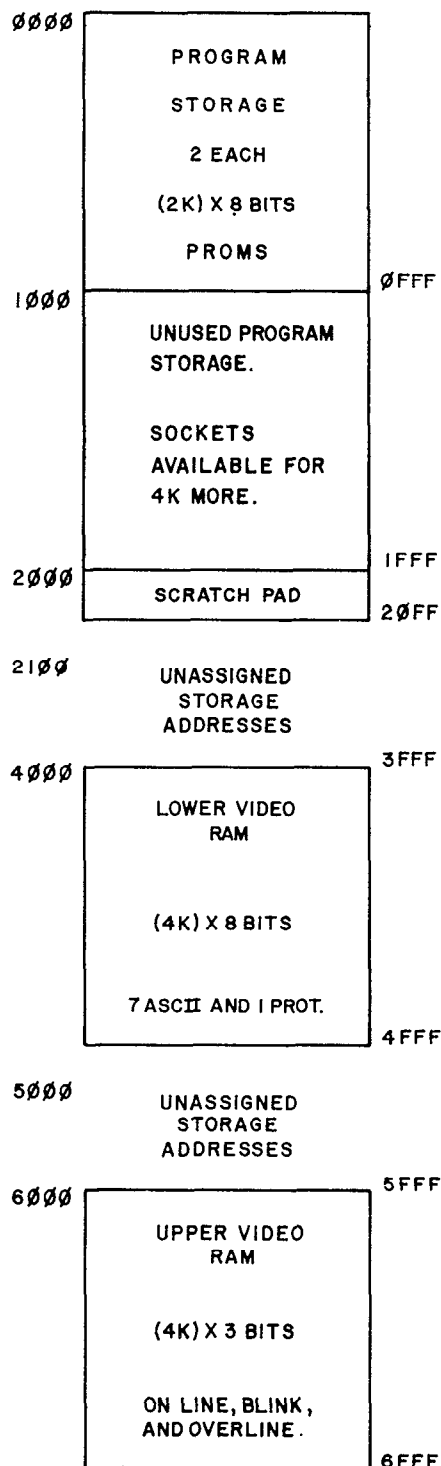


Figure 2-b. Display Memory Allocation.

control for memory write operations, but DIEN signal is required to gate memory data to external bus during read operations.

c. Video Memory. The video memory or display RAM provides constant refresh data under the control of the CPU. The video word is an 11-bit word consisting of 7 bits of ASCII-coded characters, 1 protect bit, 1 overline bit, 1 blink bit, and 1 underline bit. Each word describes one character position on the display screen. New data may also be entered into the RAM from external address and data bus under control of the microprocessor.

d. CRT and Video Logic. The video circuits fetch data from the display RAM and generate signals required to display the data on the display module screen. The screen is refreshed 50 times a second under control of the 20 MS INTERRUPT REQUEST signal.

e. Peripheral Interfaces. The read/write journal, keyboard, and controller (SIO) form the remainder of logic on the keyboard/display monitor logic board. The keyboard interface consists of an 8255 programmable peripheral interface (PPI). The PPI is under the program control of the processor. The CPU writes control words into the PPI, which directs internal and external functions. The controller interface consists of an 8251 universal synchronous/asynchronous receiver transmitter (USART) chip. The USART is a programmable communication interface that provides 9600-baud asynchronous data channel between the keyboard/display module and the terminal controller. The USART comprises a data bus buffer, read/write control logic, transmitter buffer/control, and receiver buffer/control. It converts serial data from the controller to parallel data for the keyboard/display monitor for reception, and parallel-to-serial conversion for transmission to the controller. It also provides the necessary status signal for the handshake routines.

43. TERMINAL CONTROLLER OPERATION.

The type 8080A microcomputer is used in the terminal controller in much the same manner as it is in the keyboard/display. However, in the terminal controller, it controls interfacing operations instead of display functions. Much of the same hardware is used; e.g., USART, PPI, and others. The principal differences involve the method of use and the program

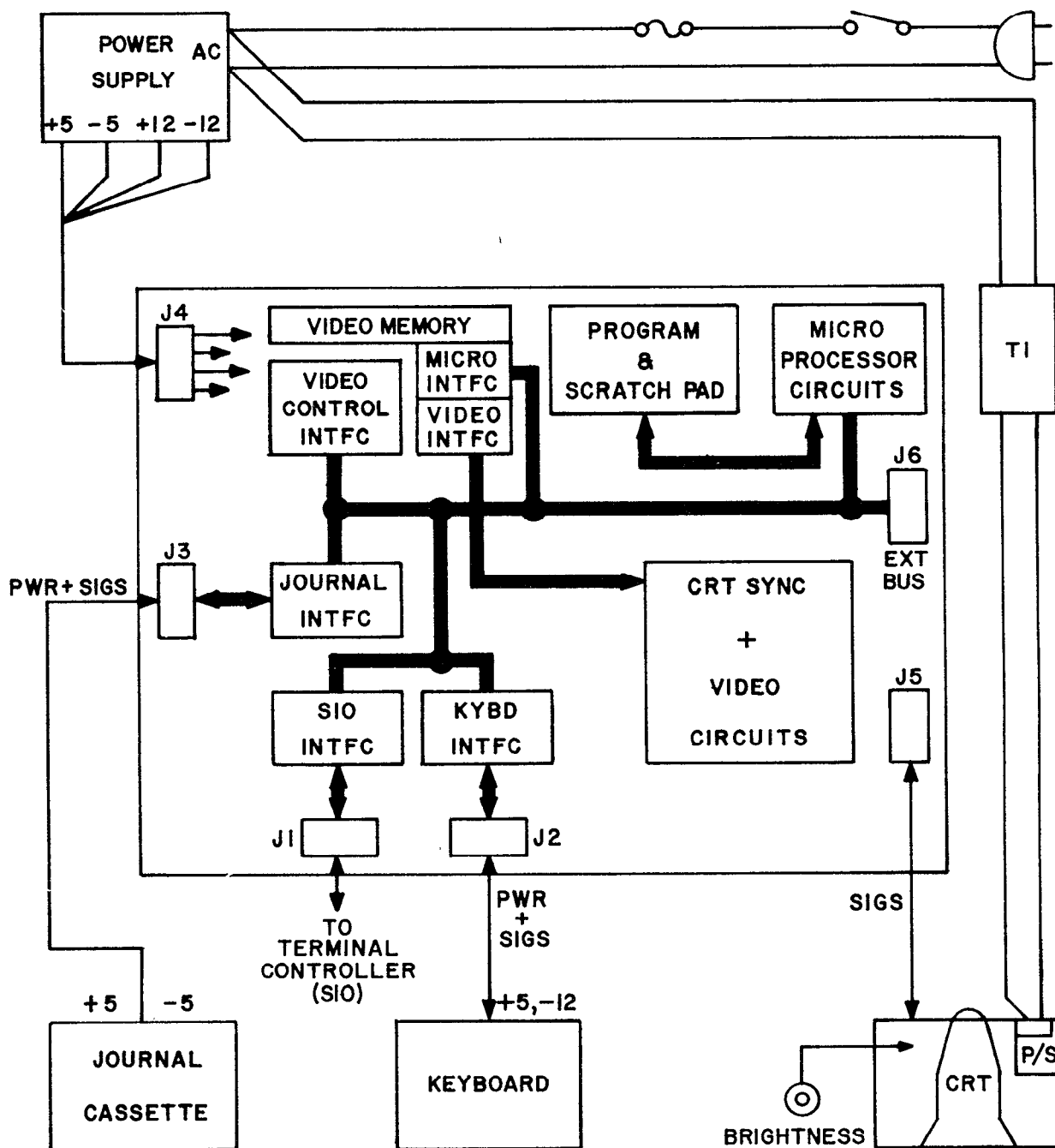


Figure 2-7. Terminal Controller Functional Diagram

differences. The memory addresses, program and main storage, and the controller interrupt system are discussed. The flow diagram is shown in figure 2-7.

a. Storage Addressing and Data Gating. The terminal controller memory allocations are shown by figure 2-8. The program is stored in seven erasable programmable read-only memories (EPROMS). EPROMS 1 through 4 hold the first 8K locations (0000H to 1FFFFH); EPROMS 5 through 7 contain the remaining 6K (4000H to 57FFFH) locations. The most significant address bits A15 through A11 are used to identify which 2K EPROM is being addressed. Bit A15 will always be low, therefore it will not be decoded. Bits A14 and A11 are decoded to provide the proper chip select (CS0 to CS6). Once the chip select occurs, address bits A10 and A0 are decoded by the selected EPROM and one byte of data appears on the data bus in lines DIN 0 to 7. Because $\overline{\text{DIEN}}$ and $\overline{\text{MEMR}}$ are active on an instruction fetch, the bidirectional bus buffers gate the data byte from the EPROM, now on DIN bus, to the microprocessor data bus. Because RAM storage occurs between addresses 2000H and 3FFFFH, address bits A14, A13, and A12 are used to identify the upper and lower RAM address areas (RAM BK1 and RAM BK0). RAM BK0 selects the lower 4K RAM addresses, and RAM BK1 selects the upper 4K of RAM addresses. A RAM ENA provides the RAM chip enable whenever $\overline{\text{MEMR}}$ or $\overline{\text{MEMW}}$ is active. Also $\overline{\text{MEMR}}$ or $\overline{\text{MEMW}}$ provides the command to the RAM to identify a read or write operation. Data is transferred to and from the RAM via DIN and DOUT through the bidirectional bus buffers, and on to the microprocessor data bus.

b. Vectored Interrupt Handling of Communication Lines and Peripheral Devices. The terminal controller uses two type 8259 priority interrupt control units (PICU) configured in a master-slave combination. The interrupt controller services interrupts from 14 devices. The 75 Hertz is the highest in priority, and the EXT

DTE is the lowest. Two type 8259 PICU's form the controller. The IR7 interrupt request input of the master PICU is connected to the INT output of the slave. This sequences in priority the slave interrupt requests behind those of the master. Interrupt servicing is essentially the same as that that occurs with a single-type 8259 PICU. The differences arise with the servicing of the interrupt requests from the slave PICU. With the interrupt request honored by the slave, the INT line to the master IR7 port is enabled. When the master PICU reaches the IR7 priority level, it will service the slave's request. The service routine involves the master issuing an INT to the type 8228 system controller. Once the microprocessor is ready to service the request, it will signal the master PICU with the first interrupt acknowledge $\overline{\text{INTA}}$. The master then generates the CALL instruction code back to the 8228 via the data bus (DB). When the 8228 system controller generates the second $\overline{\text{INTA}}$ to the master, the master signals the slave via the CAS0 to CAS2 lines with the slave identity code (001). From this point the slave enters the first byte address of the interrupt request routine. When the master receives the third $\overline{\text{INTA}}$ and signals the slave with its identity code again, the second routine address byte is gated.

c. Interfaces. The primary function of the controllers microprocessor is to control the interfaces with an EIA communications line (DCE), another DTE terminal controller (EXT DTE), and teletypewriter (tty) communications line, up to four display monitors (crt's), two printers (ptr's), and one write journal (JOURNAL). The controller microprocessor performs the same function as a large message-switching computer, only on a smaller scale. The remainder of the logic is devoted to these interface functions. Descriptions of the hardware operation of these interfaces are contained in the type FA-9669 instruction book.

44-49. RESERVED.

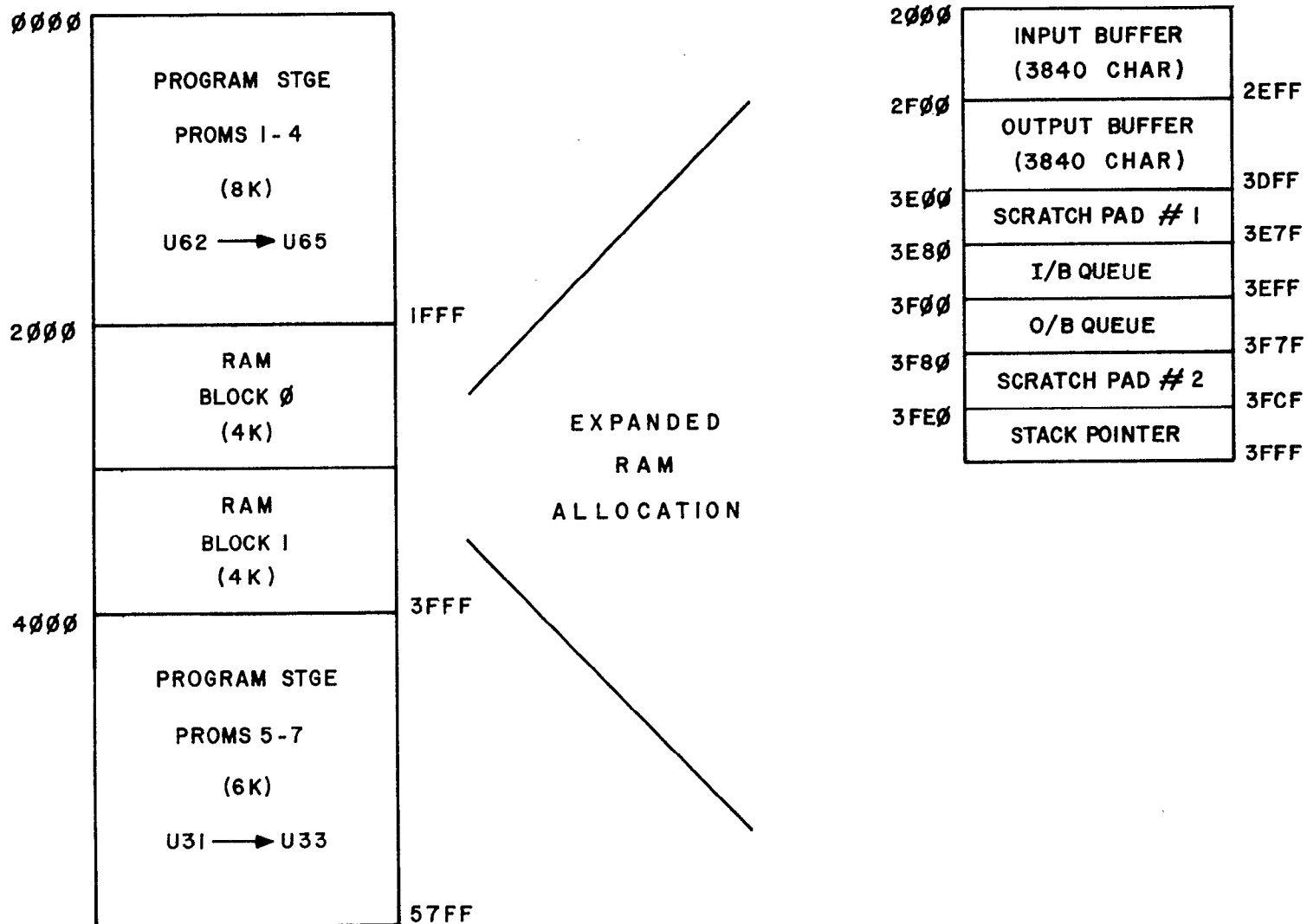


Figure 2-8. Controller Memory Allocation

CHAPTER 3. STANDARDS AND TOLERANCES

50. GENERAL.

This chapter prescribes standards and tolerances for the type FA-9669 data terminal equipment (DTE), as defined and described in Order 6000.15A, General * Maintenance Handbook for Airway Facilities. All key performance parameters and/or key inspection elements are clearly identified by an arrow (→) placed to the left of the applicable item.

51. NOTES AND CONDITIONS.

* a. **Subjective Parameters.** Certain parameters of the DTE are subjective in nature when examined for performance. These include display monitor crt resolution, linearity, size, and focus. Instructions for adjusting these parameters are contained in paragraph 98. Brightness is controllable by the terminal operator and is accessible as a front-panel control.

b. **Signal Distortion on Leased Lines.** The Federal Communications Commission (FCC) tariff under which leased lines are obtained does not establish a maximum distortion figure for the received signal. Distortion in signal loops will vary from loop to loop depending on line length, equipment used, baud rate, and type of transmission medium. Normally, under the tariff, the leasing companies only guarantee "good copy." If signal distortion appears to be excessive and the cause of errored copy, the serving test center (STC) responsible for the terminal being served should be contacted and asked to investigate and correct the excessive distortion. Other disturbances on the line such as "hits" that may be causing random errors should also be reported, when they occur, to the responsible STC.

52.-54. RESERVED.

*				
Parameter	Reference Paragraph	Standard	Tolerance/Limit	
			Initial	Operating
→55. DISPLAY CRT PERFORMANCE.				
* a. Focus.....	98e (2)	Satisfactory	Same as Standard	Same as Standard
b. Horizontal..... Linearity	98e (3)	Satisfactory	Same as Standard	Same as Standard
c. Width.....	98e (4)	Satisfactory	Same as Standard	Same as Standard
d. Height.....	98e (5)	Satisfactory	Same as Standard	Same as Standard
e. Vertical..... Linearity	98e (6)	Satisfactory	Same as Standard	Same as Standard
f. Resolution (Stepscan adjustment)	98e (7)	Satisfactory	Same as Standard	Same as Standard
				*

Parameter	Reference Paragraph	Standard	Tolerance/Limit	
			Initial	Operating
→56. SYSTEM FREQUENCY STABILITY.				
* a. Terminal Controller.....	99e (12)	16.896MHz	16.8875 to 16.9045MHz	Same as Initial
b. Keyboard/Display.				
(1) System..... Frequency	99e (14)	16.896MHz	16.8875 to 16.9045MHz	Same as Initial
(2) Character..... Clock	99e (15)	16.5438MHz	16.5355 to 16.5521MHz	Same as Initial
(3) Monitor..... Horizontal Scanning.	99e (16)	15,750Hz	15,250 to 16,250Hz	Same as Initial
c. Baud Rate Generator				
(1) 75 baud.....	99e (13) (f)	1200Hz	1190 to 1210Hz	Same as Initial
(2) 150 baud.....	99e (13) (e)	2400Hz	2390 to 2410Hz	Same as Initial
(3) 300 baud.....	99e (13) (d)	4800Hz	4790 to 4810Hz	Same as Initial
(4) 600 baud.....	99e (13) (c)	9600Hz	9585 to 9615Hz	Same as Initial
(5) 1200 baud.....	99e (13) (b)	19.2kHz	19.19 to 19.21kHz	Same as Initial
(6) 9600 baud.....	99e (13) (a)	153.6kHz	153.523 to 153.677kHz	Same as Initial
→57. DC POWER SUPPLY VOLTAGE, RIPPLE, AND NOISE LEVELS.				
a. Terminal Controller				
(1) +5V regulated dc.....	99e (1)	+ 5.0V dc	+ 4.9 to + 5.1V	Same as Initial
(2) -5V regulated dc.....	99e (3)	-5.0V dc	-4.9 to -5.1V	Same as Initial
(3) +12V regulated dc.....	99e (2)	+ 12.0V dc	+ 11.64 to + 12.36V	Same as Initial

Parameter	Reference Paragraph	Standard	Tolerance/Limit	
			Initial	Operating
* (4) -12V regulated dc.....	99e (4)	-12.0V dc	-11.64 to -12.36V	Same as Initial
(5) Ripple and noise.....	99e (5)	0V	10mV peak-to-peak	Same as Initial
b. Keyboard/Display	99e (10)	0V	10mV peak-to-peak	Same as Initial
(1) +5V regulated dc.....	99e (6)	+5.0V dc	+4.9 to +5.1V	Same as Initial
(2) -5V regulated dc.....	99e (8)	-5.0V dc	-4.9 to -5.1V	Same as Initial
(3) +12V regulated dc.....	99e (7)	+12.0V dc	+11.64 to +12.36V	Same as Initial
(4) -12V regulated dc.....	99e (9)	-12.0V dc	-11.64 to -12.36V	Same as Initial
(5) Ripple and noise.....	99e (10)	0 V	10mV peak-to-peak ac	Same as Initial
c. Display/Monitor Module (Settable)	99e (11)	70.0V dc	Same as Standard	±3.5V *
58. SIGNAL DISTORTION.				
a. Transmitting To DCE or tty Circuit.	11, 51b, 96	5 percent max	Same as Standard	Same as Standard
b. Receiving From DCE or tty Circuit.	11, 51b, 96	Error-free copy, 10 lines minimum	Same as Standard	Same as Standard
59.-69. RESERVED.				

CHAPTER 4. PERIODIC MAINTENANCE

70. GENERAL.

This chapter establishes all the maintenance activities that are required for data terminal equipment on a periodic, recurring basis, and the schedules for their accomplishment. The chapter is divided into two sections. The first section identifies the performance checks (i.e., tests, measurements, and observations) of normal operating controls and functions that are necessary to determine whether operation is within established tolerances/limits. The second section identifies other tasks that are necessary to prevent deterioration and/or ensure reliable operation. Refer to the latest edition of Order 6000.15B, *General Maintenance Handbook for Airway Facilities*, for additional guidance.

71. EXCHANGE, REPAIR, AND OVERHAUL

Exchange and repair (E&R) scheduled in this chapter as on an "as required" basis normally greater than 8 years' service. Order 4620.1, *Scheduled Overhaul of Ground Facilities Equipment*. "Overhaul" consists of removal and disassembly of subunits (main shaft, stunt box, etc.) for cleaning of all metal parts in an approved solvent (nonmetal elements shall not be immersed but shall be wiped clean); inspection of all parts for suitability of reuse; replacement of those parts not deemed reuseable (bearings, felts, springs, and lockwashers shall be replaced only as required); reassembly of unit; complete adjustment of unit; lubrication; final testing and return to normal service status.

72.-74. RESERVED.

Section I. PERFORMANCE CHECKS

Performance Check	Reference Paragraph	
	Standards & Tolerance	Maintenance Procedures
* 75. QUARTERLY. Check each display monitor for crt performance.	55	98
* 76. ANNUALLY.		
a. Check system, clock, and baud rate frequencies.	56	99
b. Check regulated dc power supplies for voltage, ripple, and noise levels.	57	99
c. Check transmitting and receiving DCE and tty signals at the signal line interface for signal distortion.	58	96
* 77. WITHDRAWN--CHG 2		
78.-79. RESERVED.		

Section 2. OTHER MAINTENANCE TASKS

Maintenance Task	Reference Paragraph	
	Standards & Tolerance	Maintenance Procedures
* 80. WEEKLY. Clean write-only and read/write..... head assemblies on journals.	--	101e (1) *
* 81. QUARTERLY.		*
a. Clean dust buildup from..... equipment enclosures.	--	101e (3)
b. Clean keyboard assembly,..... key tops, and enclosure.	--	101e (4)
c. Clean printer pressure..... roller (friction feed) and paper chute; clean sprocket mechanism (sprocket feed).	--	101e (5) (6)
d. Clean face of crt.....	--	101e (3)
* 82. ANNUALLY.		*
a. Clean filters in terminal..... controller and keyboard/ display.	--	101e (2)
b. Clean printer type..... carrier and type faces.	--	101e (7)
c. Lubricate printer	--	102
83.-89. RESERVED.		

CHAPTER 5. MAINTENANCE PROCEDURES

90. GENERAL.

This chapter establishes the procedures for accomplishing the various essential maintenance activities that are required for data terminal equipment (DTE), on either a periodic or incidental basis. The chapter is divided into two sections. The first section describes the procedures to be used in making the performance checks listed in chapter 4, section 1. The second section describes the procedures for doing the tasks listed in chapter 4, section 2. Refer to Order 6000.15A, General Maintenance Handbook for Airway Facilities, for additional general guidance. *

91. TEST EQUIPMENT.

Detailed adjustment of test equipment (control settings, use of switches, etc.) is omitted from the procedures in this chapter. The test equipment manuals contain information sufficient for the operation of such equipment and need not be duplicated. Table 5-1 lists test equipment required in this chapter by generic name and nomenclature. For additional test equipment descriptions by authorized facility, refer to Order 6200.4, Test Equipment Management Handbook.

TABLE 5-1 TEST EQUIPMENT

<i>Generic Name</i>	<i>Nomenclature</i>
Digital distortion analyzer; distortion test set (dts)	Distortion Analyzer, Communications Technology Model DTS-531P, or Data Analyzer, Stelma Telecommunications Model DMS-303A
Digital pattern generator; distortion generator	Pattern Generator, Stelma Telecommunications Model PG-303A
Data communication test set	Universal Data Systems COMTEST
* Volt-ohm-milliammeter	Simpson Model 260-6 with high voltage or equivalent
Oscilloscope	Tektronix Model T922 or equivalent
Digital multimeter	Fluke Model 8000A or equivalent
Microwave low frequency counter	E.I.P. Model 451 Microwave Counter, H.P. Model 5300B

92.-94. RESERVED.

Section 1. PERFORMANCE CHECKS

* 95. WITHDRAWN — CHG 1

96. SIGNAL DISTORTION CHECK

a. Object. The signal distortion check ensures that transmitting and receiving data signals are within the distortion limits of paragraph 58 of the standards and tolerances.

b. Discussion. If signal distortion exceeds the prescribed limits, the DTE may produce errored messages when sending to, or errored copy when receiving from, a line or circuit containing the excessive distortion. For a complete discussion of signal distortion, its measurements and identification of a specific type of signal distortion, refer to Order 6170.6. The preferred types of distortion analyzers are described in that order. These models are also listed in table 5-1 of this order.

c. Test Equipment Required. Distortion analyzers and pattern generators. Refer to table 5-1.

d. Conditions. If it is necessary to interrupt a keying loop to measure signal distortion, a spare DTE circuit should be used to avoid missing message traffic. The responsible air traffic supervisor should be coordinated before making any test that may interrupt a circuit.

e. Detailed Procedure.

(1) Select the circuit loop or termination on which the signal distortion test is to be made.

(2) Patch the distortion analyzer in the circuit and set its controls for the baud rate corresponding to that used on the circuit under test.

(3) Read the amount of distortion present on the signal. It should be within the maximum prescribed by paragraph 58a or 58b.

(4) Remove the test equipment and restore the circuit to message or data traffic.

97. POWER-ON SELF-TEST.

The DTE is capable of a "self-test" by means of a status display that appears on the crt each time the DTE is turned on. The display data indicates the positions to which the DTE operating controls are set. In addition, the date of the last software modification appears on the crt, and it also shows a four-digit number representing the memory summation through all programmable read only memo-

ries (PROMS). The later information is particularly useful in that a single bit error in PROM memory can be detected. If the displayed PROM summation is incorrect, the DTE will not function properly. At this point, replacement of the PROM chip(s) should produce a correct summation and then the DTE should perform correctly. The status display is automatically replaced by a normal data display when the DTE is put into normal operation. Should the keyboard/display be in the "EDIT" mode, the status display will be routed to the printer. This can also be used to determine satisfactory operation of the printer in addition to the printer self/test feature.

* 98. DISPLAY CATHODE RAY TUBE (CRT) ADJUSTMENT.

a. Object. This procedure provides a method of adjusting the CRT display for a clear display with a minimum amount of distortion.

b. Discussion. The display on the CRT is subjective in nature and will be adjusted to present a distortion-free display. Brightness is generally adjusted to the satisfaction of the user.

c. Conditions. The following adjustments are performed on a non-periodic basis. These adjustments correct faulty display conditions that may arise after the display monitor has operated for a long time. Equipment must be energized during CRT adjustments; therefore, exercise care to prevent personal injury. Extremely high voltage is present in the display module.

d. Test Equipment Required. See table 5-1.

e. Detailed Procedure.

CAUTION: High voltage is present. Use care in handling the CRT. Rough handling may cause implosion due to high-vacuum pressure. Do not nick or scratch the glass or subject it to any undue pressure in removal. Use goggles and have gloves for protection. Do not attempt to perform any procedure before discharging the CRT, since 14,000 volts can cause death or serious injury.

(1) Remove and disassemble the cover.

(a) Remove cables from connectors J1 (8) and J2 (9) (figure 5-1).

(b) Remove screw (10) and washer (11) that secure cover assembly to pc board bracket (12).

*

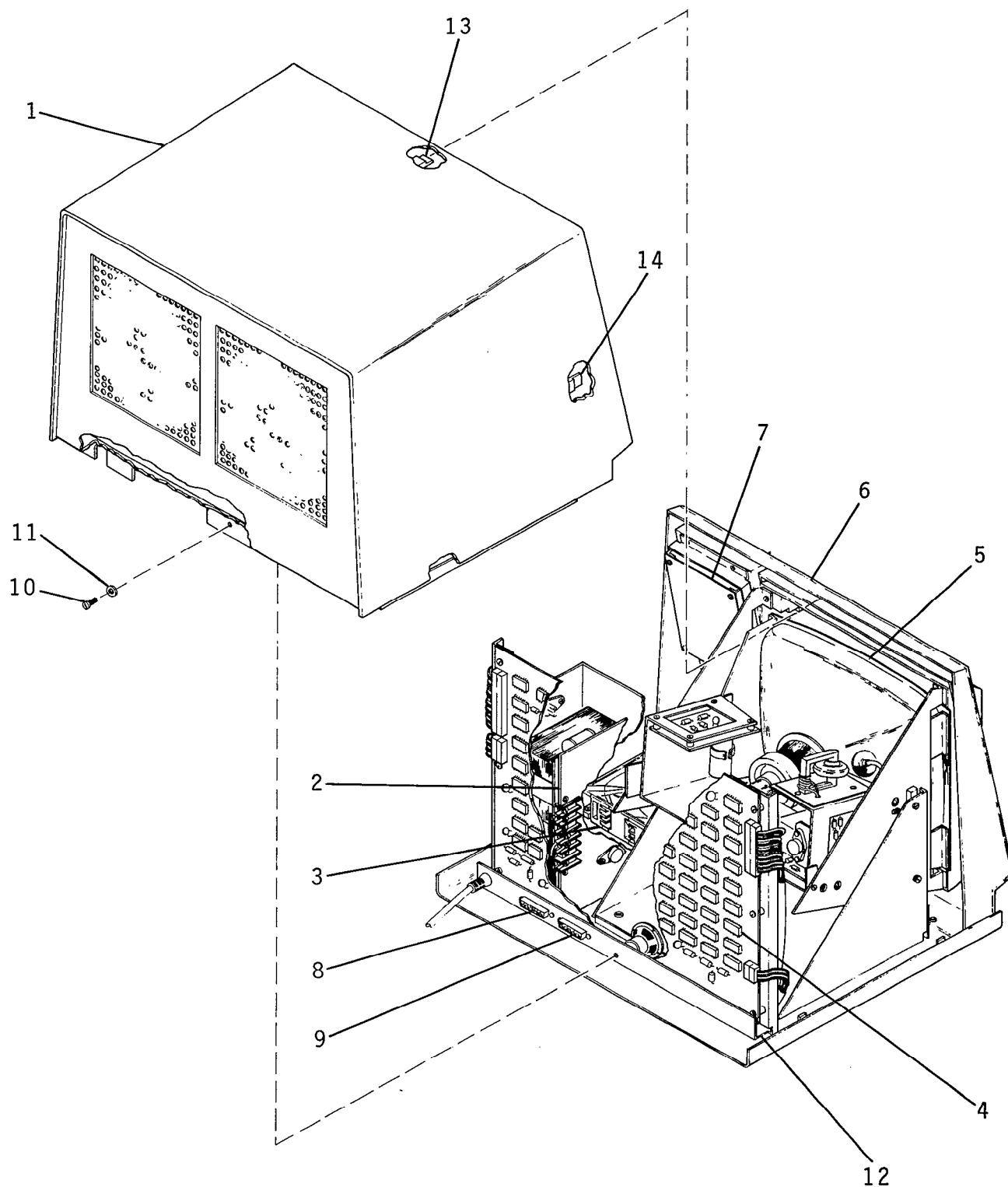


Figure 5-1. Display Monitor Major Assemblies and Cover

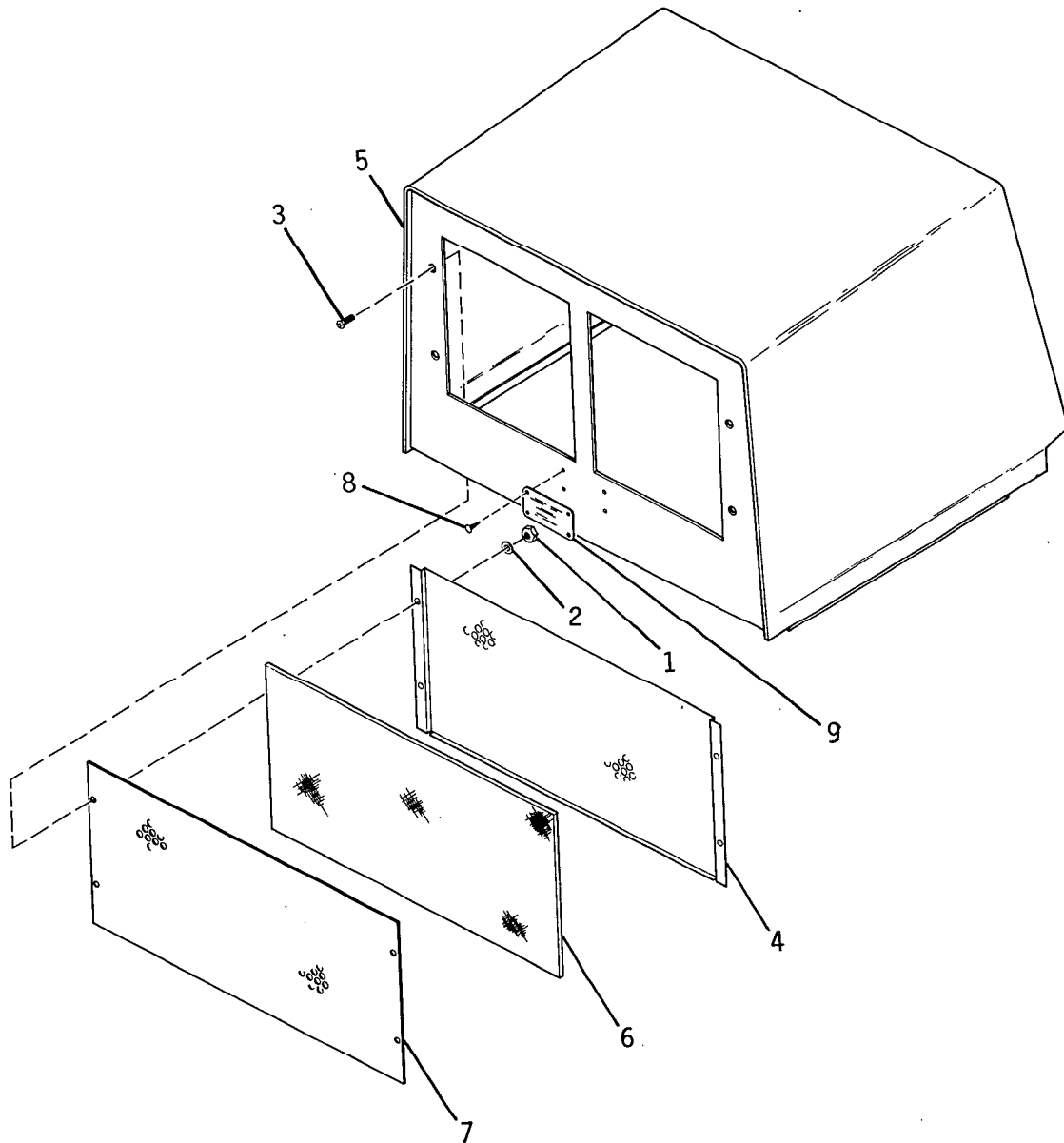


Figure 5-2. Disassembly/Reassembly of Display Monitor

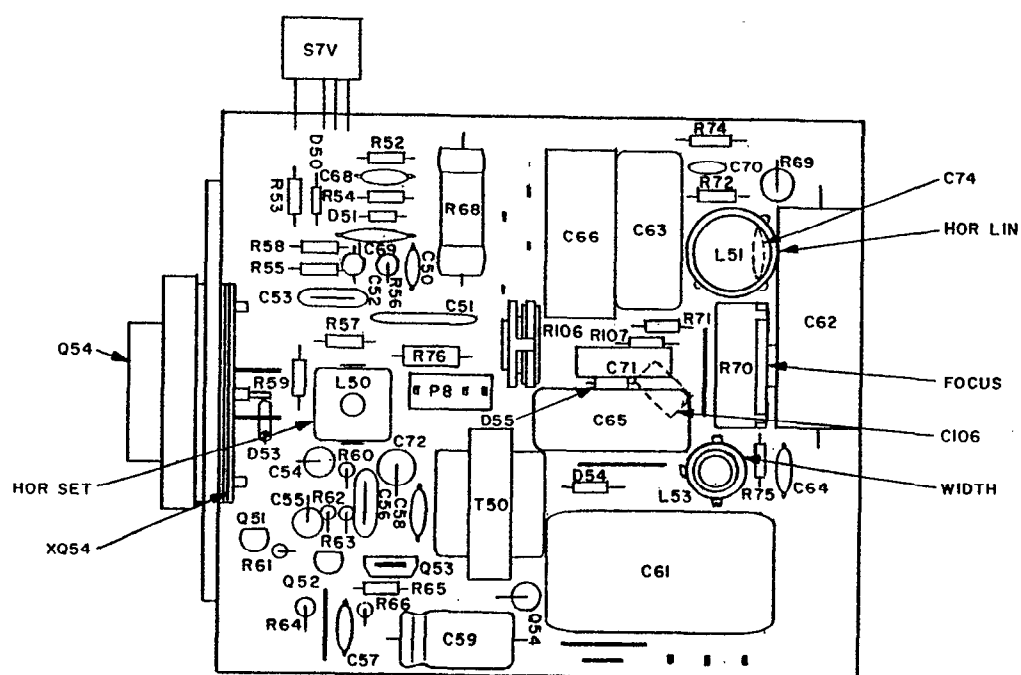


Figure 5-3. Display Module, Horizontal Circuit Card

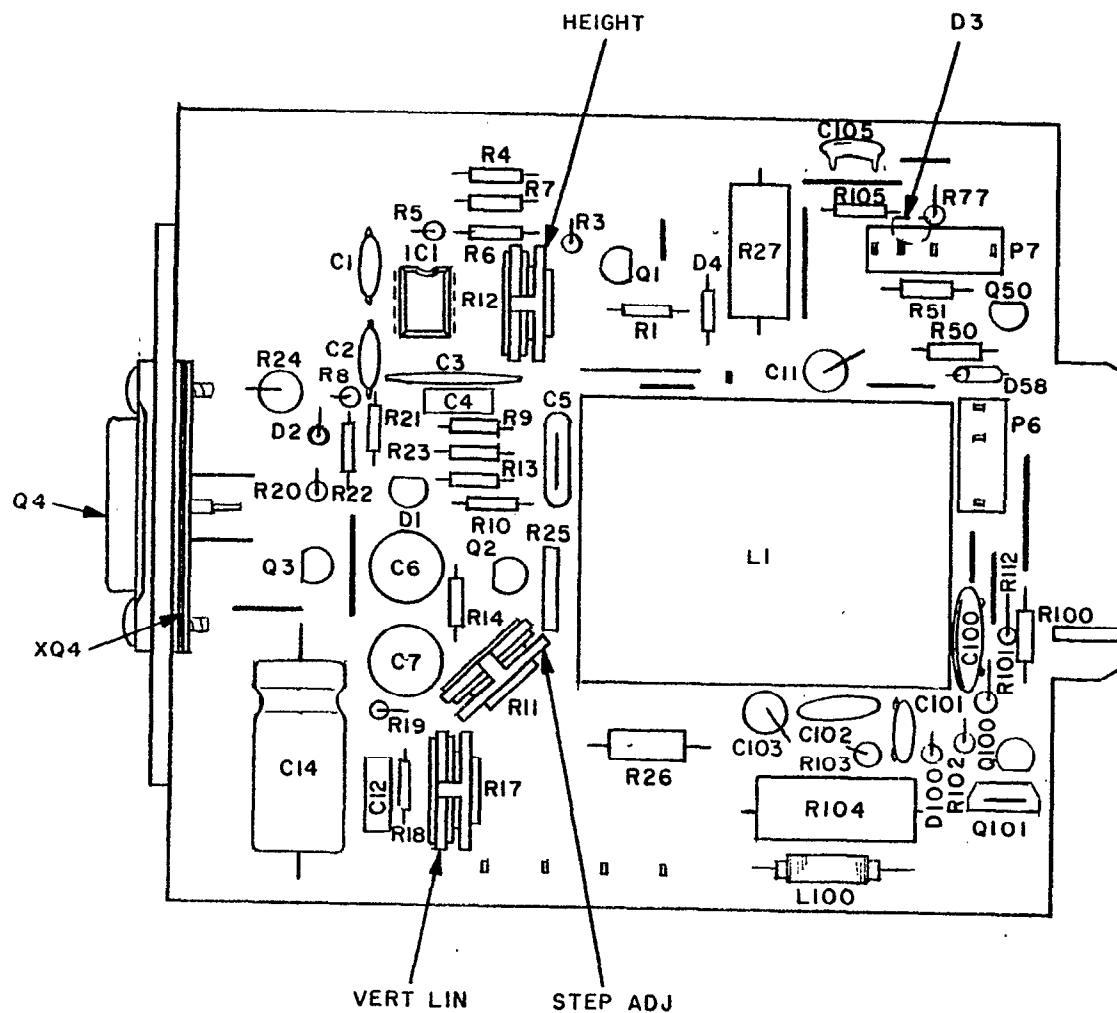


Figure 5-4. Display Module Vertical/Video Circuit Card

*

CAUTION: Do not lift rear of cover while guides (13,14) and front panel assembly are engaged, since this action may result in damage to top cover guide.

(c) Move cover backward until top and side cover guides clear front panel assembly, then lift off cover.

(d) Remove four nuts (1), washer (2), and screws (3) that secure filter bracket (4) to cover (5) (figure 5-2).

(e) Remove filter bracket (4), filter (6), and filter guard (7) from cover.

(f) Remove four screws (8) and nameplate (9) from rear cover.

(2) Focus Adjustment. If display video on CRT appears out of focus, use an insulated screwdriver and adjust FOCUS control R70 on horizontal circuit card (figure 5-3) until display video appears sharp and clear.

(3) Horizontal Linearity Adjustment. If the CRT display appears to be tearing or distorted on one side of the raster, use an uninsulated hex alignment tool and adjust HOR LIN coil L51 on horizontal circuit card until faulty display is corrected.

(4) Width Adjustment. If the CRT raster does not fill the entire width of the screen, use an insulated hex alignment tool and adjust WIDTH coil L53 on the horizontal circuit card until the raster fills the width of the screen.

(5) Height Adjustment. If the CRT raster does not fill the screen vertically, use an insulated screwdriver and adjust the HEIGHT control R12 on vertical/video circuit card (figure 5-4) until the raster fills the screen.

NOTE: This procedure may have to be repeated alternately with the vertical linearity adjustment procedure in step (6) below.

(6) Vertical Linearity Adjustment. If character display at top of screen appears larger or smaller than the character at the bottom, use an insulated screwdriver and adjust VERT LIN control R17 on vertical/video circuit card until characters at both top and bottom are the same size.

(7) Stepscan Adjustment. If the separation between character lines is less than three horizontal lines or greater than five horizontal lines, use an insulated screwdriver and adjust STEP ADJ control R11 on the vertical/video circuit card until separation between character lines is three horizontal lines (figure 5-5).

*

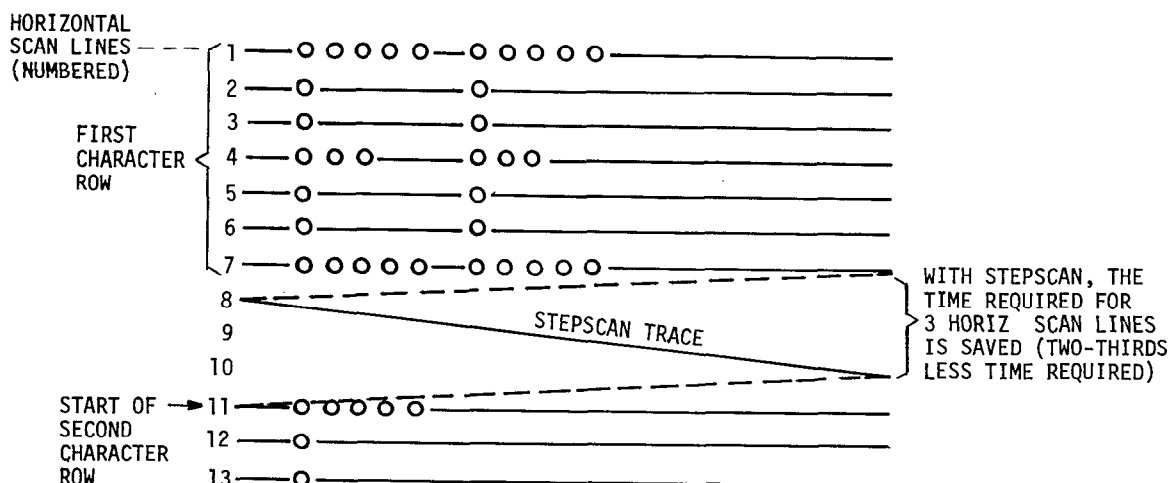


Figure 5-5. Character Display using Stepscan

* **99. EVALUATION OF SYSTEM FREQUENCIES AND POWER SUPPLIES.**

a. Object. Measurement of system frequencies and power supply voltage levels ensures the proper electrical parameters for normal operation.

b. Discussion. If frequencies and power supply levels do not meet or exceed tolerances, malfunction of the equipment and erred data is possible.

c. Test Equipment Required. See table 5-1.

d. Conditions. Use caution when working in and around live circuits. Coordinate with watch supervisor on duty if it becomes necessary to interrupt service. Out-of-tolerance readings require repair or replacement of the specific power supply. Refer to figure 5-6 for the power supply terminal numbers.

e. Detailed Procedure.

(1) Terminal Controller +5 Volt Power Supply Check.

(a) Press and release front panel POWER switch and remove ac connector from ac power outlet. The power switch-indicator should extinguish.

(b) Remove cover assembly (figure 5-1).

(c) Connect terminal controller ac connector to ac power outlet, and press and release front panel POWER switch. The POWER switch-indicator should illuminate.

(d) Connect positive lead of voltmeter to terminal 4 of power supply and negative lead to ground (terminal 3 or 6). Voltmeter should indicate between +4.9 and +5.1 volts.

(2) Terminal Controller +12 Volt Power Supply Output Check.

(a) Connect positive lead of voltmeter to terminal 1 and negative lead to ground. Voltmeter will indicate between +11.64 and +12.36 volts.

(b) Remove voltmeter.

(3) Terminal Controller -5 Volt Power Supply Output Check.

(a) Connect the negative lead of the voltmeter to terminal 2 of power supply and the positive lead to ground (terminal 3 or 6). Voltmeter should indicate between -4.9 and -5.1 volts.

(b) Remove voltmeter.

(4) Terminal Controller -12 Volt Power Supply Output Check.

(a) Connect the negative lead of the voltmeter to terminal 5. The voltmeter should indicate between -11.64 and -12.36 volts.

(b) Disconnect the voltmeter from terminal 5 and ground.

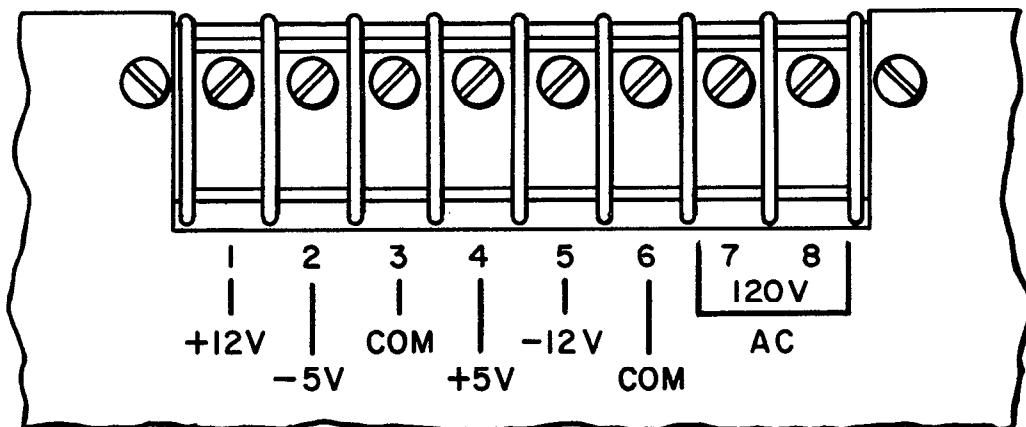


Figure 5-6. Power Supply Terminal Location

*

(5) Terminal Controller Power Supply Ripple and Noise Check.

(a) Connect the oscilloscope probe in succession to terminals 1, 2, 4, and 5 of power supply and ground lead to terminal 3 or 6. Oscilloscope displays ripple and noise with an amplitude of less than 10 mV peak-to-peak (p-p) at each terminal.

(b) Remove oscilloscope and restore equipment to normal operation.

(6) Keyboard/Display +5 Volt Power Supply Check.

(a) Set POWER switch to OFF and remove ac connector from power outlet.

(b) Disconnect keyboard assembly from display monitor assembly.

(c) Remove cover assembly from display monitor assembly (figure 5-1).

(d) Connect ac connector to ac power outlet and set POWER switch to ON. The power on lamp should illuminate.

(e) Connect positive lead of voltmeter to terminal 4 of power supply and negative lead to ground (terminal 3 or 6). The voltmeter should indicate between +4.9 and +5.1 volts.

(f) Remove voltmeter.

(7) Keyboard/Display +12 Volt Power Supply Check.

(a) Connect positive lead of voltmeter to terminal 1 and negative lead to terminal 3 or 6. The voltmeter should read between +11.64 and +12.36 volts.

(b) Remove voltmeter.

(8) Keyboard/Display -5 Volt Power Supply Check.

(a) Connect negative lead of voltmeter to terminal 2 of power supply and the positive lead to terminal 3 or 6. The voltmeter should indicate between -4.9 and -5.1 volts.

(b) Remove the voltmeter.

(9) Keyboard/Display -12 Volt Power Supply Check.

(a) Connect the negative lead of the voltmeter to terminal 5 and the positive lead to terminal 3 or 6. The voltmeter should indicate between -11.64 and -12.36 volts.

(b) Remove the voltmeter.

(10) Keyboard/Display Power Supply Ripple and Noise Check.

(a) Connect oscilloscope probe in succession to terminals 1, 2, 4, and 5 of power supply and ground lead to terminal 3 or 6. The oscilloscope displays ripple and noise with an amplitude of less than 10mV peak-to-peak (p-p) at each terminal. (Power supply not loaded.)

(b) Remove the oscilloscope.

(11) Display Module +70 Volt Power Supply Check (figure 5-7).

(a) Connect the positive lead of the voltmeter to pin 4 on connector P5 of display module power supply circuit card. Connect the negative lead to ground. The voltmeter should indicate +70 volts ± 3.5 .

(b) Set POWER switch to OFF and remove ac connector from the ac power outlet.

(c) Connect keyboard assembly to display monitor assembly.

(12) Terminal Controller Logic Board System Frequency Check (figure 5-8).

(a) Press and release front panel POWER switch and remove terminal controller ac connection from ac power outlet.

(b) Remove cover assembly.

(c) Connect terminal controller ac connector to ac power outlet and press and release front panel POWER switch. The POWER switch-indicator should illuminate.

*

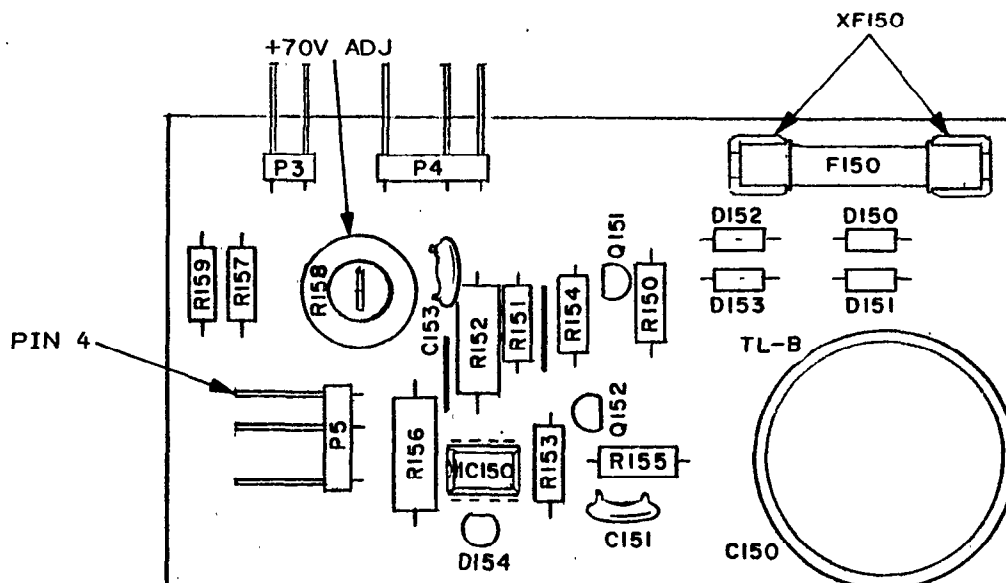


Figure 5-7. Display Module Power Supply Circuit Card

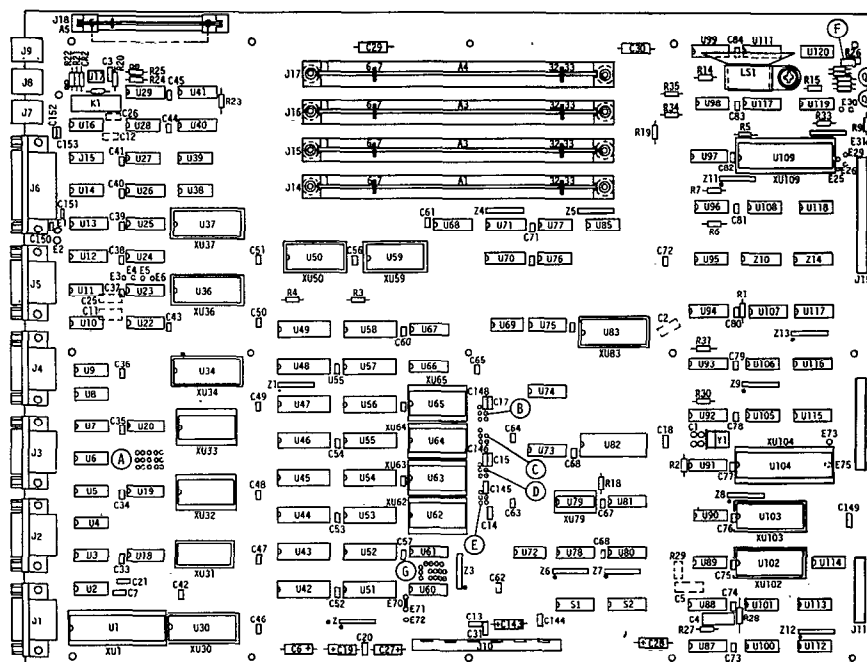


Figure 5-8. Terminal Controller Logic Board

(d) Connect frequency counter to pin 12 of U91 (clock generator and driver). The counter should read between 16.8875MHz and 16.9045MHz.

(13) Terminal Controller Baud Rate Generator Output Check (figure 5-8).

(a) Disconnect frequency counter from U91, pin 12, and connect it to U94, pin 3. The counter should read between 153.523kHz and 153.677kHz.

(b) Disconnect frequency counter from U94, pin 3, and connect it to U94, pin 13. The counter should read between 19.190kHz and 19.210kHz.

(c) Disconnect frequency counter from U94, pin 13 and connect it to U95, pin 11. The counter should read between 9385Hz and 9615Hz.

(d) Disconnect frequency counter from U95, pin 11, and connect it to U95, pin 10. The counter should read between 4790Hz and 4810Hz.

(e) Disconnect frequency counter from U95, pin 10, and connect it to U95, pin 9. The counter should read between 2390Hz and 2410Hz.

(f) Disconnect frequency counter from U95, pin 9, and connect it to U95, pin 8. The counter should read between 1190Hz and 1210Hz.

(g) Disconnect frequency counter.

(h) Press and release front panel POWER switch and remove terminal controller ac connector from ac power outlet. Replace cover assembly.

(14) Display Monitor System Frequency Check (figure 5-9).

(a) Set POWER switch to OFF and remove keyboard/display ac connector from ac power outlet.

(b) Disconnect keyboard assembly from display monitor assembly.

(c) Remove cover assembly from display monitor assembly.

(d) Connect keyboard/display ac connector to ac power outlet and set POWER switch to ON. POWER ON lamp should illuminate.

(e) Connect frequency counter to U116, pin 12 (clock generator and driver), and ground. The counter should read between 16.8875MHz and 16.9045MHz.

(f) Remove counter.

(15) Display Monitor Character Frequency Check (figure 5-9).

(a) Connect frequency counter to U110, pin 2 (from inside of chassis). The counter should read between 16.5355MHz and 16.5521MHz.

(b) Remove frequency counter.

(16) Display Monitor Horizontal Scanning Frequency Check (figure 5-3).

(a) Connect oscilloscope to either end of resistor R61 and ground. The oscilloscope should display 18 volt p-p waveform with a frequency between 15250Hz and 16250Hz.

(b) Disconnect oscilloscope. Set POWER switch to OFF.

(17) Display Monitor Vertical Deflection Frequency Check (figure 5-4).

(a) Connect oscilloscope to junction of D1 and R14 and ground. The oscilloscope should display a 4 volt p-p waveform with a frequency of between 50.1Hz and 51Hz.

(b) Disconnect oscilloscope. Set POWER switch to OFF. Remove (KB) keyboard/display ac connector from ac outlet.

(c) Replace cover assembly on display monitor assembly. Connect KB assembly to display monitor assembly.

*

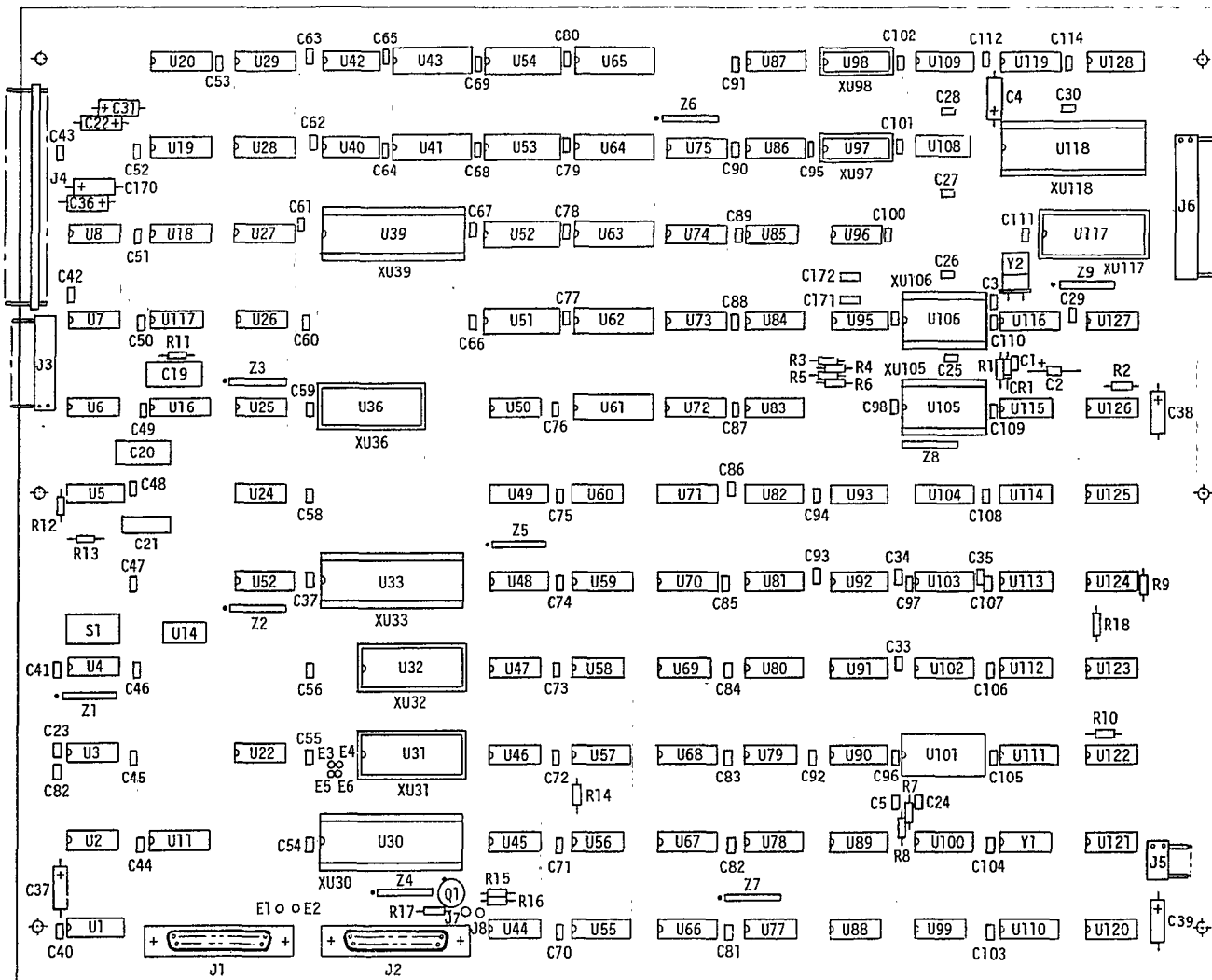


Figure 5-9. Display Monitor Logic Board

Section 2. OTHER MAINTENANCE TASK PROCEDURES

100. WITHDRAWN — CHG 1

101. CLEANING DATA TERMINAL EQUIPMENT (DTE).

a. Object. This procedure provides methodical sequence of steps in cleaning the DTE.

b. Discussion. Continuous vibration during normal operation can cause out-of-tolerance conditions of mechanical adjustments. The periodic cleaning and lubricating of the equipment provides the technician an opportunity to look for loose or missing parts and to replace or adjust before an outage occurs.

c. Conditions. Exercise caution when working with DTE. The display module uses 14,000 volts. Make sure the equipment is deenergized and that high voltage circuits are discharged before cleaning.

d. Test Equipment. None.

e. Detailed Procedure.

CAUTION: Do not use acetone or chlorinated or aromatic hydrocarbons. These chemicals will attack adhesives used in head and plastic parts on transport. Do not use tape transport until cleaning agent has dried. Make sure there is no residue on head assembly after cleaning.

(1) Tape Head Transport Assembly Cleaning. Using a cotton-tipped applicator, liberally apply isopropyl alcohol to recorder head and other surfaces that make contact with tape. Remove any excess solution immediately.

(2) Terminal Controller Cleaning.

(a) Slide cover assembly back until cover chassis guide clears front panel assembly and remove cover assembly.

CAUTION: Dry-cleaning solvents are flammable and should be used only in a well-ventilated area away from any open flame. Dry-cleaning solvents evaporate quickly and have a drying effect on the skin. Use gloves to prevent cracks in the skin, and mild irritation or inflammation.

(b) Use a dry brush to remove any dust and loose *

* dirt that has accumulated on inside of cover assembly, logic board assembly, power supply, front panel assembly, journal (write only), and fan assembly.

NOTE: If 6 months have elapsed since the filters were cleaned, perform steps (c) through (g); if not, proceed to step (g).

(c) Remove the eight screws, washers, and nuts that secure the two filter brackets, filters, and filter guards to the cover assembly (figure 5-10). Separate filters from brackets and guards.

(d) Wash filters in warm soapy water; rinse in clean water and allow them to dry.

(e) Install filters between filter guards and filter brackets.

(f) Install both filter assemblies on cover assembly and secure them with eight screws, washers, and nuts.

(g) Clean surface of cover assembly with a damp cloth until all traces of dirt and stains are removed. Should any stains resist cleaning by this means, use a dry-cleaning solvent to remove stains.

(h) Reassemble the terminal controller cover assembly.

(3) Display Monitor Assembly Cleaning (figure 5-1).

(a) Separate keyboard and display monitor assemblies as follows:

1 Remove and retain screw (10) and washer (11) that secure cover assembly to pc board bracket (12).

CAUTION: Do not lift rear of cover while guides (13, 14) and front panel assembly are engaged, since this action may result in damage to top cover guide.

2 Move cover backward until top and side cover guides clear front panel assembly, and lift off cover.

(b) To disassemble the cover, remove the filter brackets, filters, filter guards, and nameplates as follows (figure 5-2): *

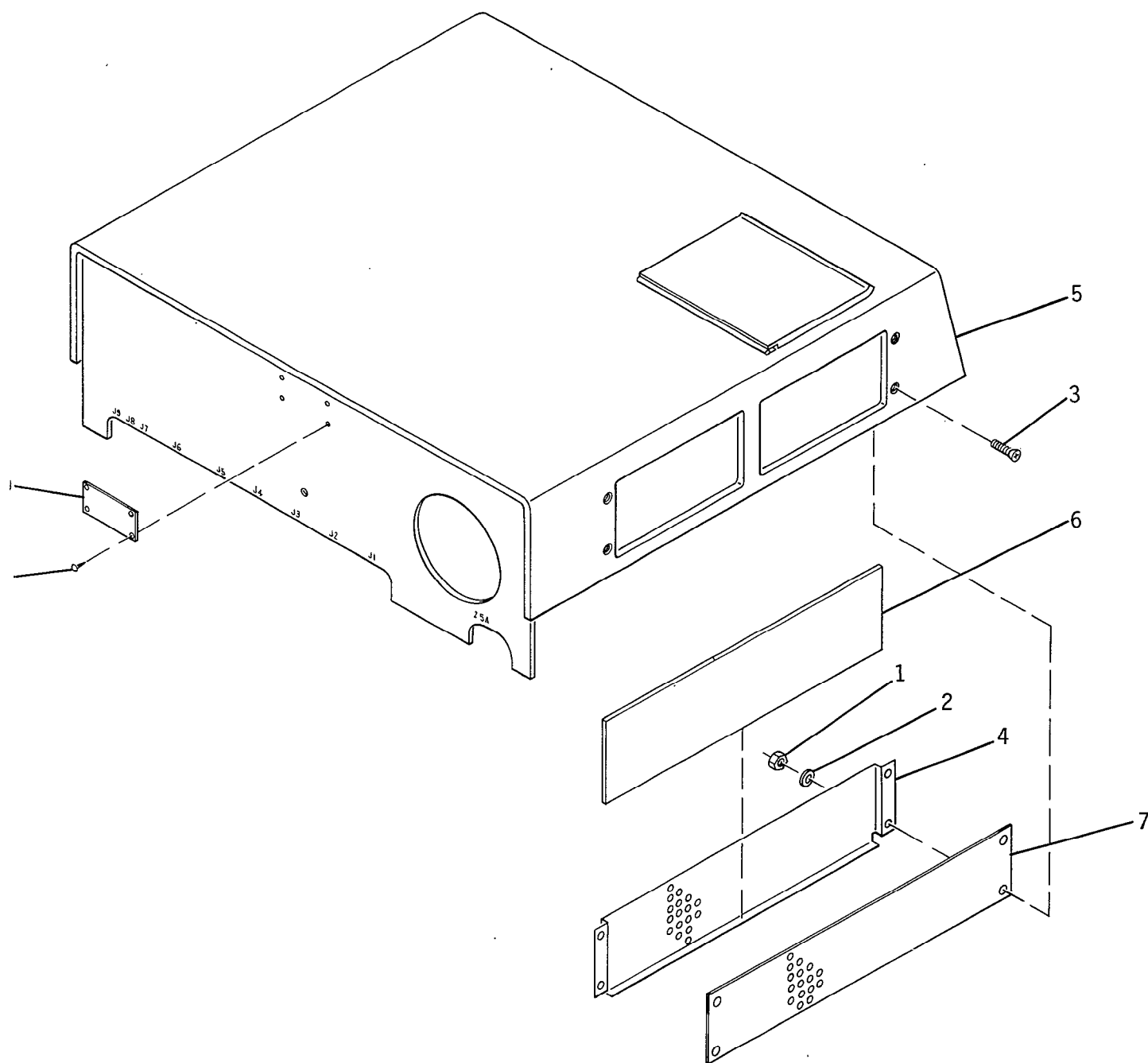


Figure 5-10. Disassembly/Reassembly of Terminal Controller Cover Assembly

*

1 Remove four nuts (1), washer (2), and screws (3) that secure filter bracket (4) to cover (5).

2 Remove filter bracket, filter (6), and filter guard (7) from cover.

3 Remove four screws (8) and nameplate (9) from rear of cover.

(c) Use a dry brush to remove any dust and loose dirt that has accumulated inside of cover assembly, logic board assembly, power supply, front panel, journal (read/write), and fan assembly.

(d) Clean surface of cover assembly with a damp cloth until all traces of dirt and stains are removed. Should any stains resist cleaning by this means, use a dry-cleaning solvent to remove stains.

(e) Clean face of CRT with a soft damp cloth until all traces of dirt have been removed. Then dry with a soft dry cloth.

NOTE: If 6 months have elapsed since the filter was cleaned, perform steps (f) through (i); if not, proceed to step (i).

(f) Remove four screws, washers and nuts that secure filter bracket, filter and filter guard cover assembly (figure 5-2). Separate from bracket and guard.

(g) Wash filter in warm soapy water; rinse in clean water and allow it to dry.

(h) Install filter between filter bracket and filter guard.

(i) Install filter assembly on cover assembly and secure it with four screws, washers, and nuts.

(j) Replace display monitor cover assembly.

(4) Keyboard Assembly Cleaning:

(a) Remove eight screws, washers, and nuts (four in front and four in back) that secure cover assembly to base assembly; lift off cover assembly.

(b) Use a dry brush to remove any dust and loose dirt that has accumulated on keyboard assembly and inside cover assembly.

(c) Clean surface of cover assembly and individual keys with a damp cloth until all traces of dirt and stains

are removed. Should any stains resist cleaning by this means, use dry-cleaning solvent to remove stains.

(d) Install cover assembly on base assembly and secure it to base assembly with eight screws, washers, and nuts.

(5) Friction Feed Printer Cleaning (figure 5-11).

(a) Turn off power to printer using power switch at rear of printer cabinet.

(b) To gain access to printer area, lift lid of printer cabinet and open front door. Remove interior cover from printer.

NOTE: When interior cover is removed, safety interlock switch is open, ensuring that power to printer is cut off.

(c) Use a dry brush to remove dust and paper debris that has accumulated in the paper chute.

(d) Clean pressure roller with a damp cloth and dry with a clean cloth.

(e) Use a dry brush to remove any loose dirt from type carrier.

(6) Sprocket Feed Printer Cleaning (figure 5-12).

(a) Turn off power to printer using power switch at rear of printer cabinet. To gain access to the printer area, lift lid of printer cabinet and open front door.

(b) Use a dry brush to remove any dust and paper debris that has accumulated around the sprocket mechanism.

(c) Clean pressure roller with a damp cloth and dry with a clean cloth.

(7) Type Carrier Cleaning.

(a) Remove the type carrier and place in a pan containing mineral spirits. Allow to soak for 5 minutes.

(b) Brush the face of the pallets and wipe dry with a clean cloth.

(c) After cleaning the type carrier, make sure the pallets are all aligned by using the 402878 pallet depth gage. Use the correct side of the gauge (80-column printer or 132-column printer).

(d) Restore power to the printer and return to service.

*

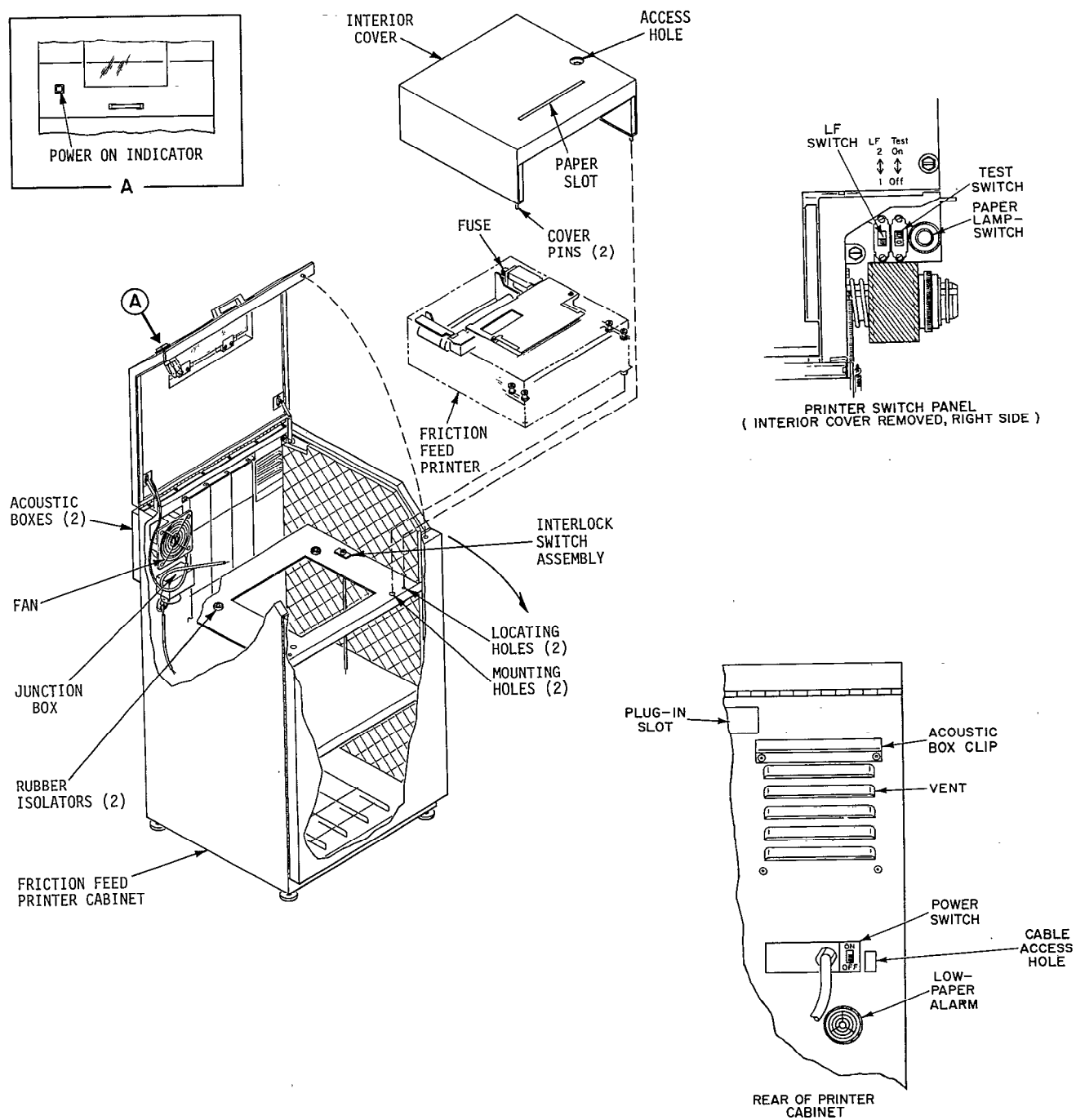


Figure 5-11. Friction Feed Printer Controls and Indicators

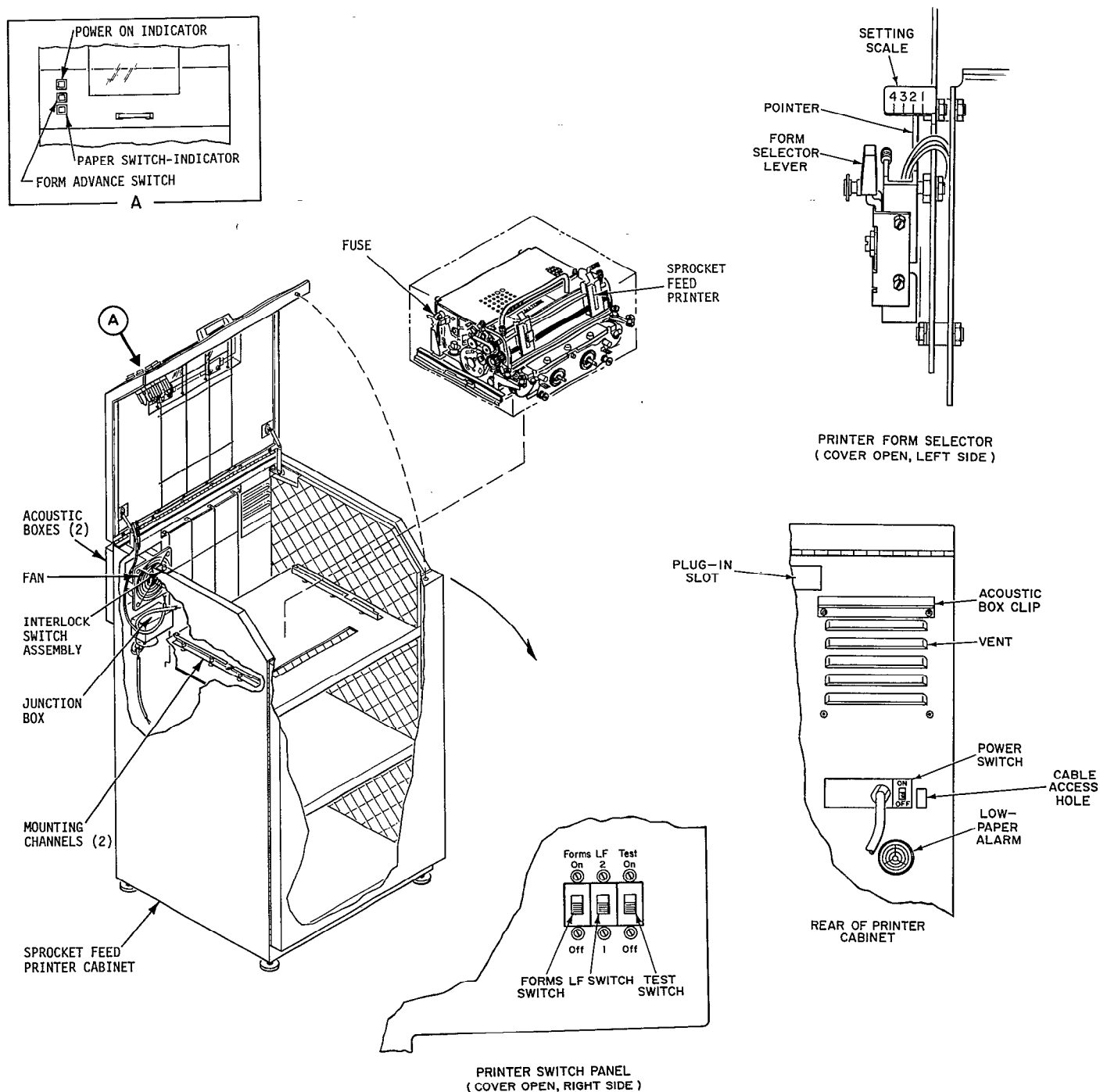


Figure 5-12. Sprocket Feed Printer, Controls, and Indicators

* **102. LUBRICATING DATA TERMINAL EQUIPMENT (DTE).**

a. Object. This procedure provides a method for lubricating the printer.

b. Discussion. This procedure applies to both the tractor feed printer and the friction feed printer, unless otherwise indicated.

c. Conditions. The general lubrication requirements consist of using oil, Teletype part number 88970, at all locations where the use of oil is indicated and grease, Teletype part number 88973, on all surfaces where grease is indicated. Felt oilers should be saturated with oil and excess removed by wiping lightly with a clean cloth. In illustrations (figures 5-13 through 5-19) the numbers 01, 02, 03, etc, refer to drops of oil. The letter symbols indicate the following:

- O** Oil 88970
- G** Apply a thin film of 88973 grease.
- S** Saturate felt oilers, washers, and wicks with oil.
- D** Keep dry, no lubricant permitted.

Closed ball bearings do not require lubrication (impeller shaft). Pack open ball bearings with 88973 grease (right casting assembly). Avoid over lubricating.

d. Detailed Procedure.

(1) Friction Feed Printers.

(a) Oil motor shaft, ribbon guide rollers, ribbon carrier, and pressure roller shaft bearings (figure 5-13).

(b) Oil paper tension roller bearings and pivots.

(c) Lubricate the left side of the printer at points indicated in figure 5-14.

NOTE: Lubrication of some parts is necessary and accessible only during extensive disas-

sembly or overhaul. Do not over lubricate the paper feed clutch and pulley bearing. Over lubrication of these parts will cause oil to be thrown on the circuit card.

(d) Lubricate the right side of printer as indicated in figure 5-15.

NOTE: The type carrier must be removed to gain access to the lubricating pad.

(2) Tractor Feed Printer.

(a) Lubricate the ribbon guide rollers (both sides) and ribbon carrier as indicated in figure 5-16.

(b) Lubricate the left side of the printer as indicated in figures 5-17 and 5-18.

(c) Lubricate the right side of the printer as indicated in figure 5-17.

NOTE: The type carrier must be removed to gain access to the wick.

(3) Print Head Assembly Lubrication (figure 5-19).

(a) The hammer bank has been lubricated with dry lubricant and should not be oiled or greased, unless the printer has been disassembled and this assembly cleaned. In this case, each hammer should receive the equivalent of one to two drops of applied **sparingly** with a brush over the entire surface of the hammer.

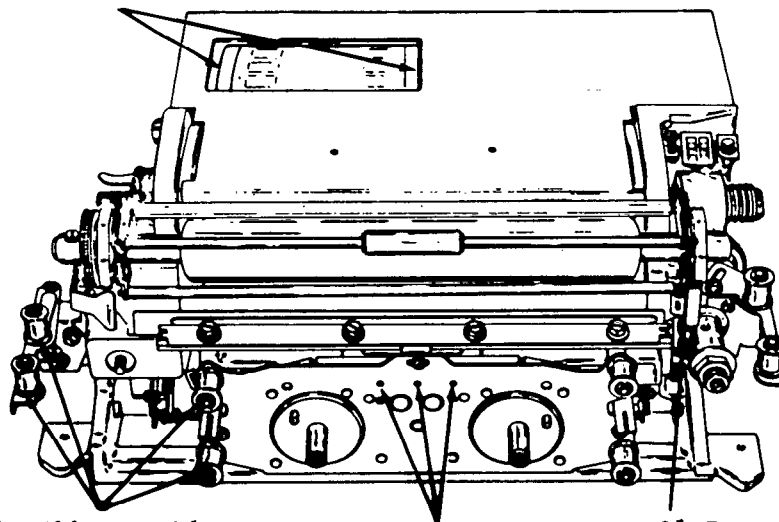
(b) The armature bank assembly should be brushed with a light film of grease on all armature tips.

(c) The interposer bank assembly has been lubricated with dry lubricant and should receive no oil or grease unless the printer has been disassembled and this assembly cleaned. In this case, each interposer should receive the equivalent of one to two drops of oil applied **sparingly** with a brush over the entire surface of the interposer.

*

Front and Top

01 Motor Shaft
Bearings (Both Ends)

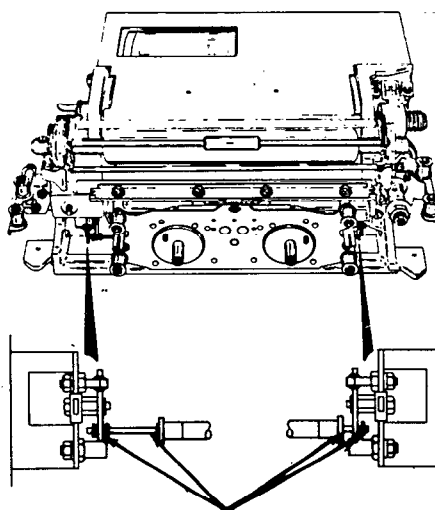


01 Ribbon Guide
Rollers
(4 Places --
Each Side)

02 Ribbon Carrier
Mechanism
(3 Holes)

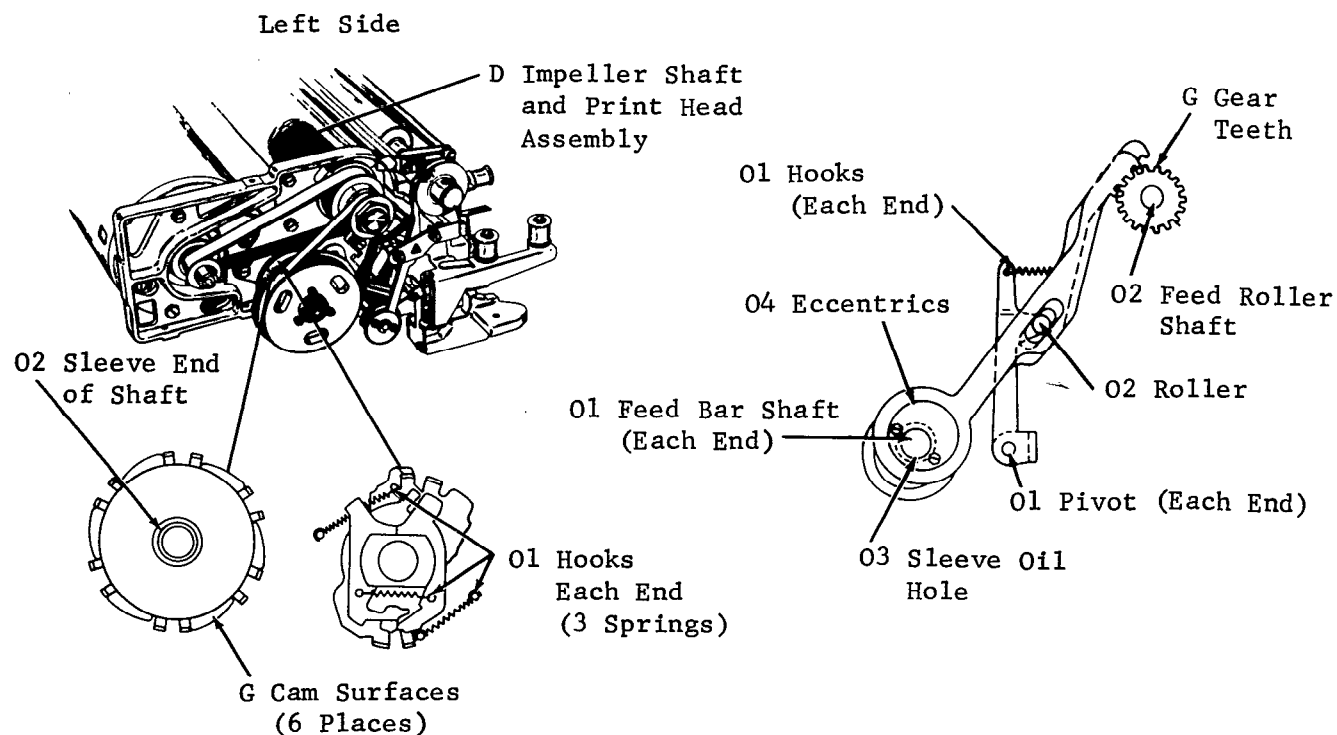
01 Pressure Roller
Shaft Bearings
(6 Places --
Each Side)

Front



01 Paper Tensioner Roller
Bearings and Pivots

Figure 5-13. Friction Feed Printer, Front and Top View



NOTE: Access to this area requires disassembly. Lubrication is only done at time of original assembly or during extensive disassembly or overhaul.

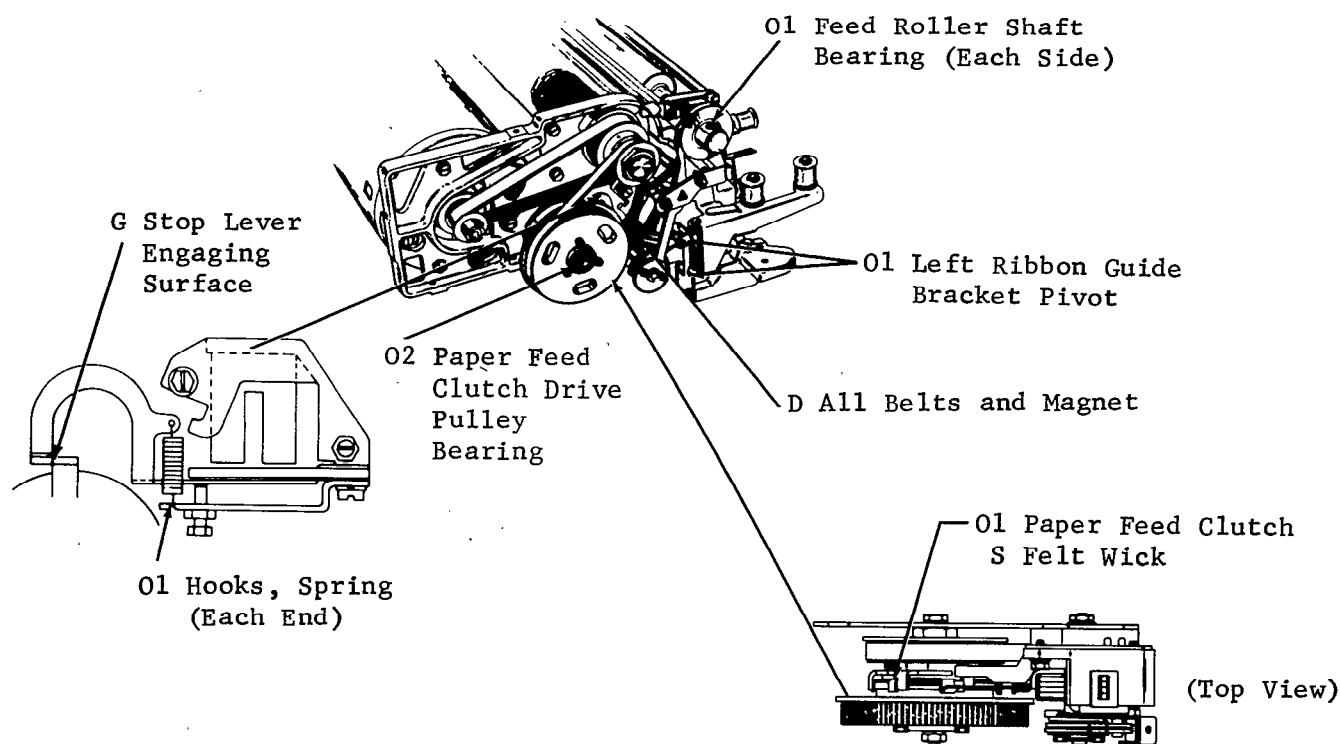


Figure 5-14. Friction Feed Printer, Side and Top View

NOTE: The type carrier must be removed to gain access to the pad.

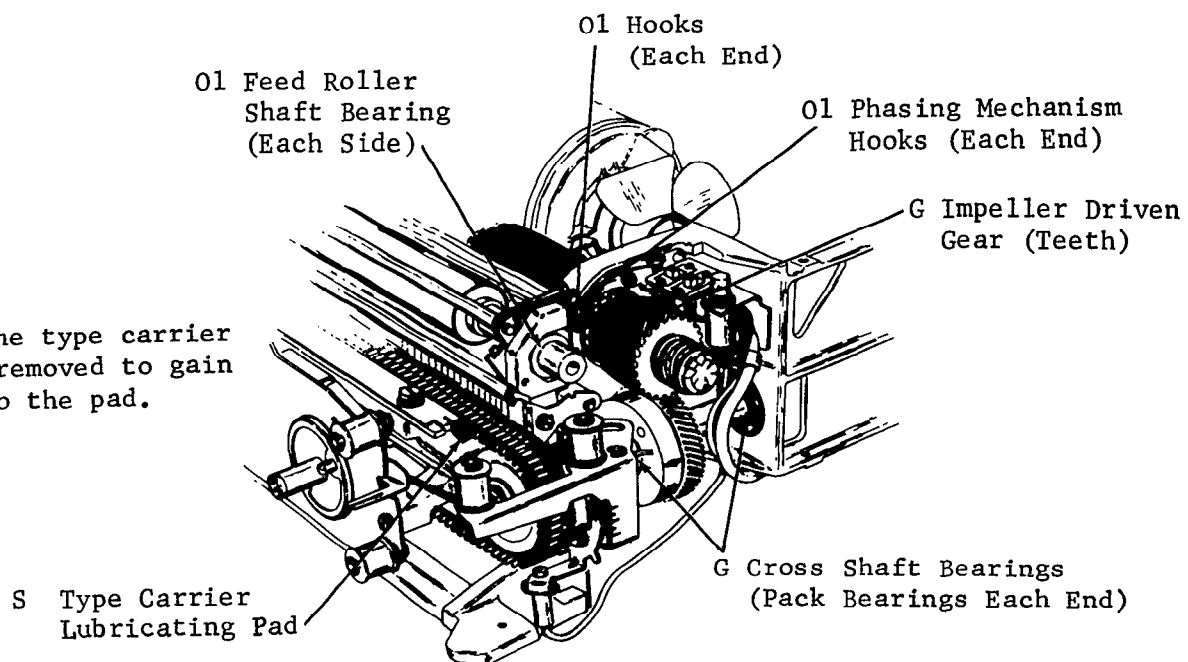


Figure 5-15. Friction Feed Printer, Right Side View

Front Top

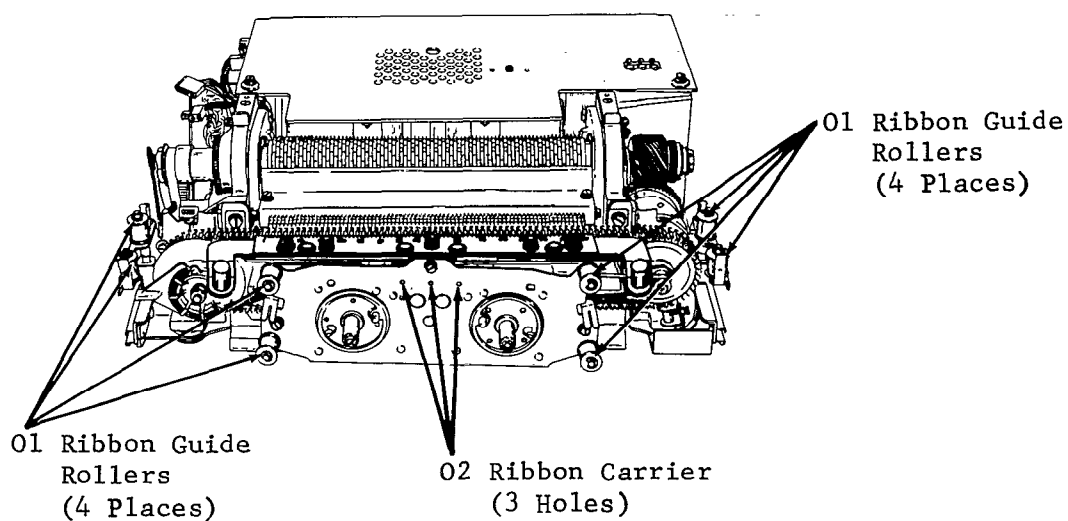
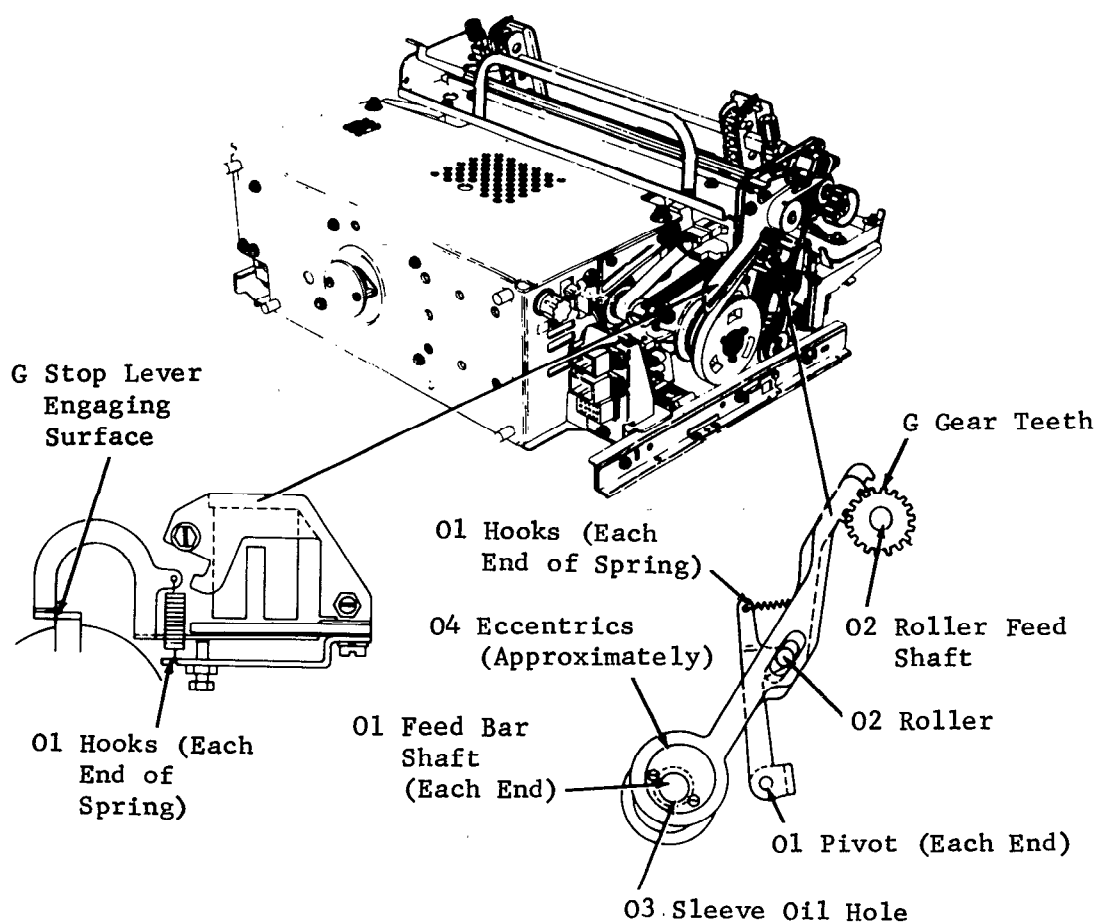
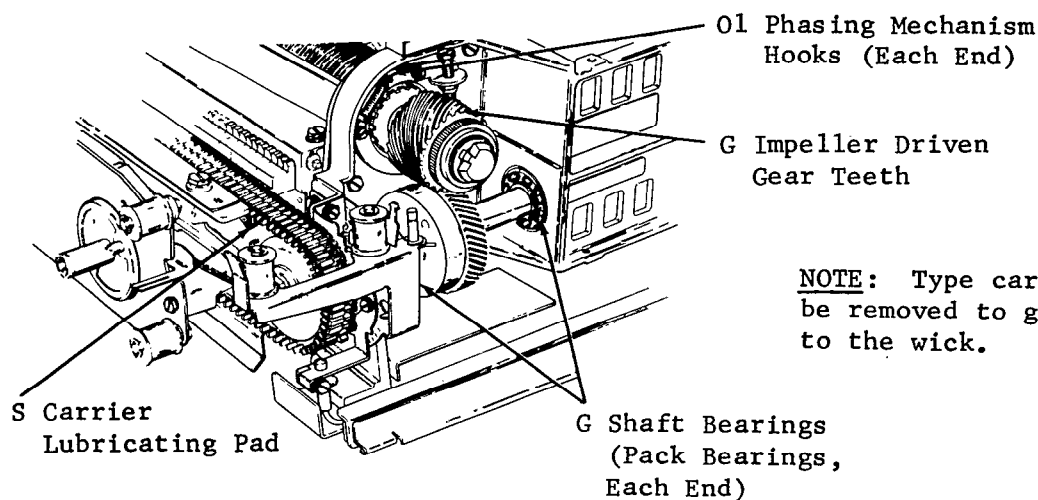


Figure 5-16. Tractor Feed Printer, Top View

Left Side



Lubrication -- Right Side



NOTE: Type carrier must be removed to gain access to the wick.

Figure 5-17. Tractor Feed Printer, Side View

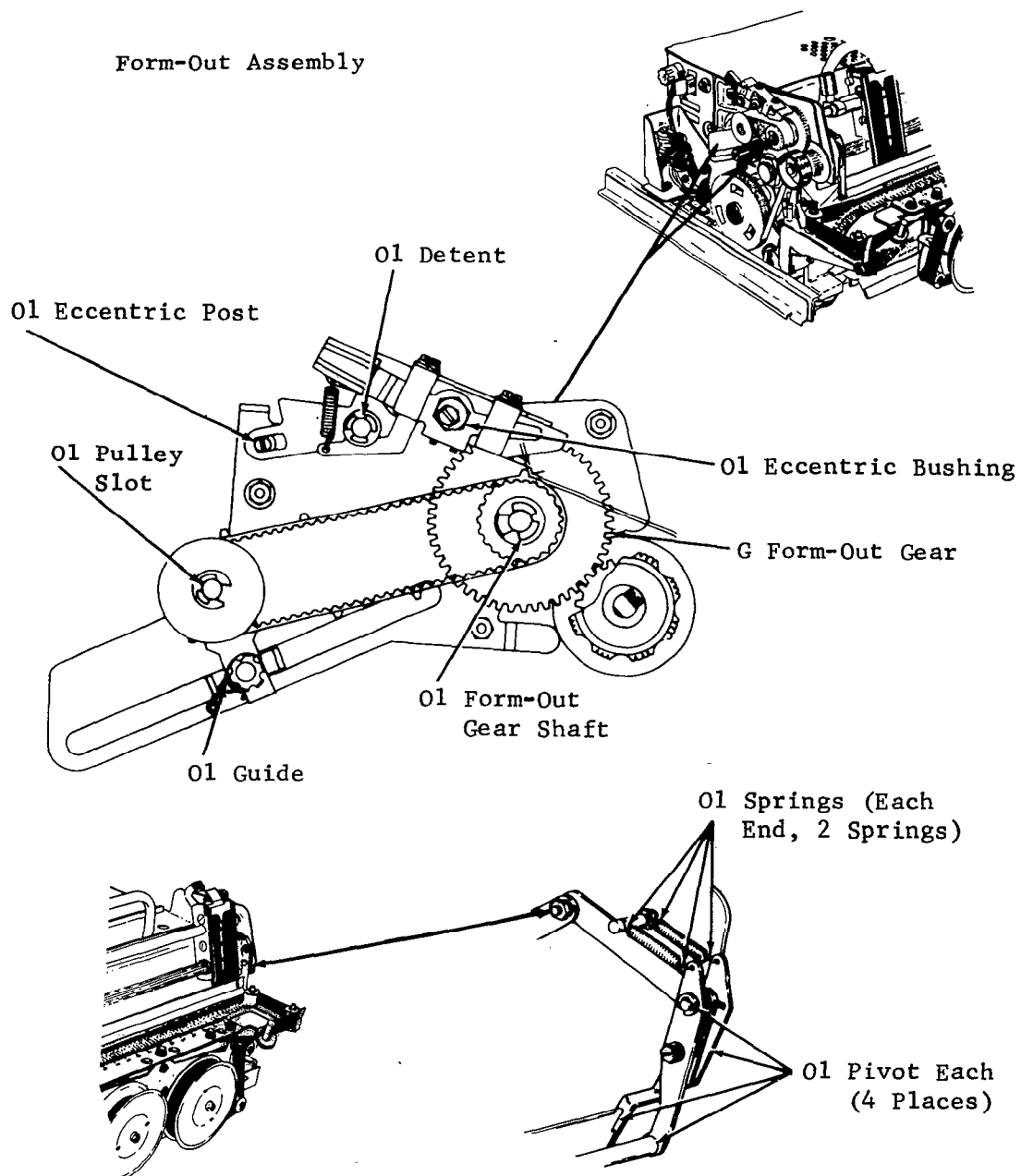
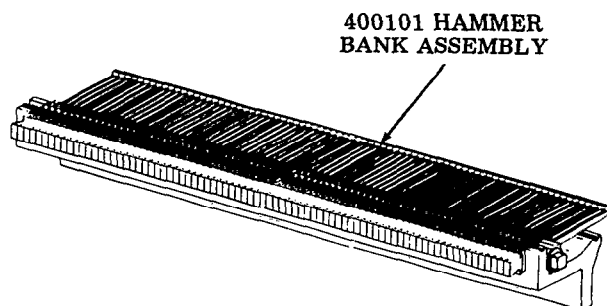
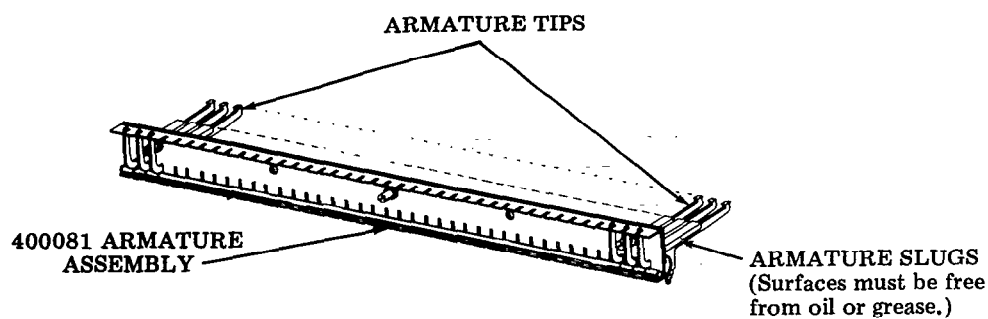
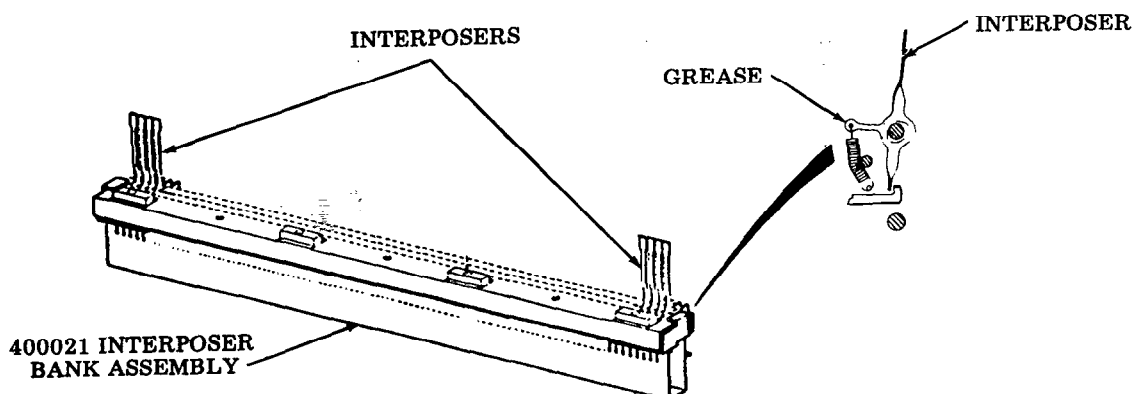


Figure 5-18. Tractor Feed Printer, Left Side View

Hammer Bank AssemblyArmature Bank Assembly

Brush a light film of grease on all armature tips.

Interposer Bank Assembly

Brush a small amount of grease into interposer loop where interposer spring is anchored.

Figure 5-19. Printer Subassemblies

APPENDIX 1. GLOSSARY

Address. In the 8080A microprocessor, a 16-bit number that identifies a memory location.

Align. To adjust to form a line; to set to equivalent specifications.

ASCII. Pronounced "askee," this is an acronym for "American Standard Code for Information Interchange." It is the accepted term, although a more recent title is "USA Standard Code for Information Interchange" (USASCII). It has 128 possible information and function combinations. See Eight-Level Code in this glossary.

Asynchronous. Having a variable time interval between successive bits, characters, or events. The term asynchronous is usually applied to serial start-stop transmission.

Bias. The effect of distortion whereby one type of pulse becomes longer while the opposite type of pulse is shortened.

Blinding. The automatic suppression of unwanted functions or selective calling signals (e.g., address codes of other than the local station) from appearance in printer copy or punched tape.

Busy Line. The condition of a signal line that is carrying intelligence pulses.

Byte. A group of eight contiguous bits occupying a single memory location in the 8080A microprocessor.

Character. A Baudot code sequence, consisting of a start pulse (space), five variable pulses (mark or space), and a stop pulse (mark), which can represent a letter or function, such as: A, B, CR, LF, etc.

Codes. The language used to translate keyswitch depressions into signal logic output. The standard data handling codes in FAA include USA Standard Code for Information Interchange (USASCII) and Baudot (a and start-stop bits and the latter, a five-level code

using start-stop bits in addition to the five intelligence bits.

Comsec. A contraction for "communication security" commonly applied to equipment and/or systems for encryption, transmission, and decryption of classified messages or data.

Conditioning. The process of receiving certain code characters, which will in turn allow a station to copy only those messages intended for that station.

Demarcation. Boundary. Used to describe a terminal strip at which connections are made between the serving company's circuits and those of the customer.

Device Code. The 8-bit code for a specific input or output device. When decoded by external decoders, it generates a single-device select pulse.

Distortion. A change or alteration of normal shape. Electrically, a change produced, usually unintentionally, in a waveform.

Distributor. A device used to transmit electrical pulses in a definite order to the signal line.

EBCDIC. Pronounced "ebseedick," an acronym for "extended binary coded decimal for information code," an eight-level code with 256 possible information and function combinations.

EIA RS-232. An Electronic Industries Association (EIA) specification concerning the voltage interface requirements between data-handling terminal equipment and data communication channel equipment. The standard defines a means of exchanging control signals and serial binary data signals between terminal and communications equipment. Letter suffixes indicate the latest edition.

Eight-Level Code. A code used for data transmission having seven intelligence bits, one parity bit, one start bit, and two stop bits. The ASCII (or USASCII) is

an example of this code.

End Distortion. That type of distortion, not normally encountered, that either adds to or subtracts from the trailing edge of the numbered marking pulses.

Five-Level Code. A code used for data transmission having five intelligence bits, one start bit, and one stop bit. The latter is normally 1.42 times the length of the other bits to allow for differences in machine timing. The BAU-DOT code is an example.

Flag. A circuit (flip-flop) that provides a signal that indicates that an input/output device is ready to receive or transmit data from or to a computer.

Fortuitous. Happening by chance, accidental, not planned.

Fortuitous Distortion. A random and intermittent form of distortion, such as might be caused by lightning.

Framing Bits. Usually, the start and stop elements of a signaling code consisting of one character.

Full Duplex. A circuit on which information can be transmitted simultaneously in two directions, with each direction independent of the other.

Garble. A distorted or interrupted transmitted code sequence, which results in an unreadable copy of the transmission.

Ground Rules. Standards, conventions, or practices recognized by the FAA and a leasing or serving company for the interconnection of leased and customer-owned teletypewriter circuits or equipment.

Half Duplex. A circuit on which information can be transmitted in either direction, but in only one direction at a time.

Handshaking. Handshaking is exchange of data or control information in two directions on a bus or at an interface.

Hard Copy. Paper printout of a data-handling terminal.

Hit. A momentary disturbance on a circuit. In data communication, a hit duration less than a bit length may garble one or more characters, particularly in an asynchronous mechanical selector system.

Idle Line. A teletypewriter transmission line that is in a steady-state marking condition, a closed loop or circuit having normal continuous current flow for a period greater than the time required to transmit a complete character, this time being 100 milliseconds when operating at 100 words per minute.

APPENDIX 2. DEFINITIONS OF LOGIC AND CIRCUIT CODES FOR DTE

CODE	DEFINITION	CODE	DEFINITION	CODE	DEFINITION
AAG	AUDIBLE ALARM GATE	FL	FILTER	RCB	REVERSE CHANNEL BUFFER
AB	ADDRESS BUFFERS	FMT	FORWARD MOTION TENSION	RCBT	REVERSE CHANNEL BREAK TIMER
ADD	ADDRESS DECODER	FRC	FORWARD AND REVERSE GATING	RCC	RECIRCULATE CONTROL
ALD	ALARM DRIVER			RCKG	READ CLOCK GENERATOR
AR	ATTRIBUTE REGISTER	GAT	GATE	RCL	REVERSE CONTROL LATCH
		GDET	GAP DETECTOR	RCT	RECTIFIER
BBB	BIDIRECTIONAL BUS DRIVER			RCTR	REFRESH ADDRESS COUNTER
BC	BRIGHTNESS CONTROL	HCTR	HORIZONTAL LINE COUNTER	RD	READ CIRCUIT
BCAC	BELL CODE ALARM CONTROL	HID	HORIZONTAL INTERVAL DECODER	RDVR	REGULATOR DRIVER
BCAD	BELL CODE ALARM DRIVER	HO	HORIZONTAL OUTPUT	REF	REFERENCE
BCAG	BELL CODE ALARM GATE	HOS	HORIZONTAL OSCILLATOR	REG	REGULATOR
BCTC	BUFFER CONTENT AND TRANSMIT CONTROL REGISTER	HPS	HORIZONTAL PULSE SHAPER AND DRIVER	RFV	REFERENCE VOLTAGE
BCTI	BUFFER CONTENT AND TRANSMIT INDICATOR CONTROL	HSA	HORIZONTAL SYNC AMPLIFIER	RK	RECEIVE KEYS
BCTR	BINARY COUNTER	HSD	HORIZONTAL SYNC DRIVER	RMT	REVERSE MOTION TENSION
BEG	BUS ENABLE GATE				
BFF	BLINK FLIP FLOP	ID	IDENTIFY OR IDENTIFIER		
BLC	BLANKING CONTROL	IDB	TTY IDENTIFIER BUFFER	SAMP	SERVO AMPLIFIERS
BLD	BI-PHASE LEVEL DECODER	IDR	TTY IDENTIFY REGISTER	SCD	STATE COUNTER DECODER
BLE	BI-PHASE LEVEL ENCODER	IDS	IDENTIFIER SELECTOR	SCSW	SPEED CONTROL SWITCHING
BRG	BAUD RATE GENERATOR	IDSW	EIA IDENTIFY 1 AND 2 SWITCHES	SDVR	SERVO DRIVERS
BRR	BAUD RATE CONTROL REGISTER	IG	INITIALIZING GATE	SEG	SELECTOR ENABLE GATE
BT	BLINK TIMER	INT	INTEGRATOR	SGAT	SAFETY GATE
BUF	BUFFER	INV	INVERTER	SHP	SHAPER
		IRFF	INTERRUPT REQUEST FLIP FLOP	SHC	SWITCH MONITOR/IN-SERVICE INDICATOR CONTROL
CAMP	CLOCK AMPLIFIERS	ISID	IN/OUT SERVICE INDICATOR DRIVERS	SMT	SCHMITT TRIGGER
CC	CURSOR COUNTER			SS	SYNC SHAPER
CKGD	CHARACTER CLOCK GENERATOR AND DRIVER	JIM	JOURNAL INTERFACE MODULE	SSA	STEP SCAN CIRCUIT
CKKG	CHIP ENABLE CLOCK GENERATOR	KDP	KEYBOARD/DISPLAY PORT	SSC	STEP SCAN CONTROL
CCTR	CHARACTER COUNTER	KE	KEYBOARD ENCODER	SSI	STANDARD SERIAL INTERFACE
CD	CONTROLLER AND DRIVER	KIM	KEYBOARD INTERFACE MODULE	SSMV	START STOP CONTROL MULTIVIBRATOR
CG	CHARACTER GENERATOR	KMX	KEYBOARD MATRIX	STG	SPACE TIME GENERATOR
CGR	CHARACTER GENERATOR REGISTER			SYC	SERVO SPEED CONTROL
CH	CLOCK HEAD				
CKCG	CLOCK CONTROL GATES	LCD	LINE COUNTER DECODER	TAMP	TAPE CLOCK AMPLIFIER
CKGD	CLOCK GENERATOR AND DRIVER	LD	LINE DRIVER	TCKG	TRANSMIT CLOCK ENABLE GENERATOR
CLT	CONTROL LATCH	LIIC	LINE INTERRUPT INDICATOR CONTROL	TCTR	30-MSEC DELAY COUNTER
CMP	COMPARATOR	LR	LINE RECEIVER	TDC	TAPE DIRECTION CONTROL
CPU	CENTRAL PROCESSING UNIT	LTFF	LOW TAPE FLIP FLOP	TK	TRANSMIT KEYS
CRT	CATHODE RAY TUBE CIRCUIT			TRD	READ HEAD
CT	CONTROL TIMER			TSC	TAPE SPEED CONTROL
CTR	COUNTER			TWR	WRITE HEAD
		MC	MOTION COMMAND	USART	UNIVERSAL SYNCHRONOUS/ASYNCHRONOUS RECEIVER/TRANSMITTER
DAMP	DATA AMPLIFIER	MEM	MEMORY	VAMP	VIDEO AMPLIFIER
DBC	DYNAMIC BREAKING GATE	MMUX	MEMORY ADDRESS MULTIPLEXER	VDR	VIDEO DATA REGISTERS
DCKG	DATA SHIFT CLOCK GENERATOR	MP	MICROPROCESSOR	VDVR	VERTICAL DRIVER
DCS	DC SUPPLY	MS	MODULE SELECTORS	VID	VERTICAL INTERVAL DECODER
DCTR	DIVIDE COUNTER	MTG	MARK TIME GENERATOR	VMD	VIDEO MODULATOR AND DRIVER
DDC	DISPLAY DATA CONTROL	MUX	MULTIPLEXER	VO	VERTICAL OUTPUT
DEC	DECODER	OET	OPTICAL END OF TAPE	VOC	VERTICAL OSCILLATOR
DGAT	DATA GATE	OLAD	OPEN LINE ALARM DRIVER	VSA	VERTICAL SYNC AMPLIFIER
DIF	DIFFERENTIATOR	OLAG	OPEN LINE ALARM GATE	VSD	VERTICAL SYNC DRIVER
DMC	DIRECTION MEMORY CIRCUIT	OVP	OVERVOLTAGE PROTECTION	VSR	VIDEO SHIFT REGISTER
DMUX	DEMUTIPLEXER				
EGAT	ENABLE GATE	PC	PARKING CIRCUIT	WCD	WARNING CONTROL DECODER
ELTC	END OF TAPE/LOW TAPE CONTROL	PDET	PHASE DETECTOR	WCKG	WRITE CLOCK GENERATOR
EMEM	END OF TAPE MEMORY	PDVR	PARKING DRIVERS	WIL	WARNING INDICATOR LATCH
ET	ELECTRONIC TENSION	PG	PULSE GENERATOR	WIRG	WARNING INDICATOR RESET GATES
ETC	END OF TAPE CIRCUIT	PGAT	PARKING GATE	WR	WRITE CIRCUIT
ETG	END OF TAPE GATE	PIC	PRIORITY INTERRUPT CONTROLLER		
ETMV	END OF TAPE MULTIVIBRATOR	PP	PRINTER PORT		
		PS	POWER SUPPLY		
		PSFF	PRINTER STATUS FLIP FLOP		
		PSP	PHASE SPLITTER		
FGAT	FLUX GATE	RAMP	REFERENCE AMPLIFIER		
FGC	FLUX GATE CONTROL	RBUF	REGULATOR BUFFER		

INSTRUCTIONS FOR FAA FORM 1800-2

Block 1. Prescreening Office - Field or Region Case Files

ASM-150 (National Airways Engineering Field Support Sector) - For Plants and Structures, Radar, NAVAIDS, Communications and Light Systems.

ASM-160 (National Automation Engineering Field Support Sector) - For Automation Hardware, and Functional and Maintenance Software.

ATR-100 (Systems Plans and Programs Division) - All AT case files that do not come under ATR-200 jurisdiction

ATR-200 (Automation Software Division) - Relating to existing ATC operational software.

NOTE: For Headquarters offices, ASM-150, ASM-160, AAC, and ACT case files refer to NAS-MD-001, Paragraph 6.

Waiver of Installation or siting criteria case files should be submitted directly to ASE-220.

Block 2. End Item Number. This block refers to the level of detail which subsystems are defined in NAS-MD-001 - (See paragraph 12, Cross Reference).

Block 3. Scope of Change

Local: Case file is local in scope (e.g., waiver; applies to one or more sites; not national).

Test: Case file is for a limited duration and site(s) must be specified.

National: Case file is national in scope (applicable to all items of type specified).

NAS Plan: Case file affecting items under the NAS Plan (may require F&E capital).

Block 4. Case File Number (alphanumeric character code). This should be a discrete identification number issued by originator's organization.

a.) First 5 characters identify originating organization (i.e., EA400; ZLAAF; TR250, etc.)

b.) Center Group of 2-5 characters represent system case file is affecting (i.e., CD, FDEP, EARTS, etc.)

c.) Last three characters denote consecutive number by that organization on specific system (i.e., 001, 006, etc.)

d.) A, B, C added at end of case file number for amendment to that case file.

Block 5. Program Element. Represents NAS functions as depicted in NAS Plan for Facilities Equipment and Associated Development (Brown Book).

Block 6. Life-cycle Phase: Requirements Determination: Case files affecting NASSRS, Level I Design Document (NAS-DD-1000), or NAS System Spec (NAS-SS-1000)

Subsystem Acquisition: Case Files affecting subsystem procurement specifications, IRD's, or ICD's.

Operational: Case files affecting operating systems.

Block 7. Priority

Normal: Classification for case files that do not meet criteria classified as urgent or time critical.

Time Critical: Classification restricted to changes truly requiring expeditious processing (i.e., need CCD by certain date, to support schedule of other projects, budget related, etc.) Reason and required data must be specified in Block 21.

Urgent: Classification for case files which will prevent a prolonged outage or catastrophic failure or correct unsafe conditions. Include explanation in Block 21.

NOTE: See Order 6032.1 for authorization of hardware emergency modifications.

Blocks 8-9. Supplemental Change Form/Number. Fill in if appropriate reference documentation is attached.

Blocks 10-11. Baseline Document Type/Number. Fill in appropriate baseline documents affected.

Blocks 12-15. Self Explanatory

Block 16. Facility Identifiers. Eleven character field consisting of Region, Facility and Location (e.g., WPARSRBAM) per Facility Master File, for local or test.

Block 17. Facility Code. Refer to FAA Order 1375.4A - Five character code which breaks the facility down to its lowest unit (e.g., 45512 = ASDE-2).

Block 18. FA Type Number. Complete, if applicable.

Block 19. Serial Number. Complete for local or test case files only.

Block 20. Title. Give nomenclature of subject; spell all acronyms out fully; include location and runway, if applicable.

Block 21. Description. Give as much information pertaining to change as possible. Include identification of problem, proposed change, impact (operational reliability, maintainability, resources, etc.), cost, benefits, schedules, justification of Time Critical/Urgent. Attach additional sheets if necessary.

Blocks 22-24. Self Explanatory. Make sure all proper coordination is accomplished before forwarding on for processing, include any comments.

Block 25. Prescreening Review. Accomplish prescreening requirements and recommend approval or disapprove case file. List must evaluators that are recommended for review.

If disapproved, return original to originating office with explanation and send a copy to ASE-220.

Block 26. CM Use Only. This block is for notification of status, changes, impacts, etc., on case file. It is also used for withdrawals and cancellation of NCP's.

NAS CHANGE PROPOSAL (Please Type or Print Neatly)		FOR CM USE	Date Received	NCP Number	Page 1 of
1. Prescreening Office <input type="checkbox"/> APM-150 <input type="checkbox"/> ATR-100 <input type="checkbox"/> APM-160 <input type="checkbox"/> ATR-200 <input type="checkbox"/> _____	2. End Item Number	3. Scope of Change <input type="checkbox"/> Local <input type="checkbox"/> National <input type="checkbox"/> Test <input type="checkbox"/> NAS Plan		4. Case File Number	
5. Program Element <input type="checkbox"/> En Route <input type="checkbox"/> Flight Service <input type="checkbox"/> Interfacility Comm <input type="checkbox"/> Terminal <input type="checkbox"/> Ground-to-Air <input type="checkbox"/> Maint & Ops Support <input type="checkbox"/> Other _____		6. Life-Cycle Phase <input type="checkbox"/> Requirements Determination <input type="checkbox"/> Subsystem Acquisition <input type="checkbox"/> Operational		7. Priority <input type="checkbox"/> Normal <input type="checkbox"/> Time Critical <input type="checkbox"/> Urgent	
8. Supplemental Change Form <input type="checkbox"/> RCP <input type="checkbox"/> ECR <input type="checkbox"/> Emp. Sugg. <input type="checkbox"/> _____	9. Supplemental Change Number	10. Baseline Document Type <input type="checkbox"/> CPFS <input type="checkbox"/> IRD/ICD <input type="checkbox"/> T.I. <input type="checkbox"/> EEM/PEM <input type="checkbox"/> Spec. <input type="checkbox"/> Maint. Handbk. <input type="checkbox"/> Dwg. <input type="checkbox"/> _____		11. Baseline Document Number	
12. Originator	13. Originator's Organization	14. Telephone Number		15. Date Initiated	
16. Facility/Identifier (FACID)	17. Facility Code	18. FA Type Number		19. Serial Number	
20. Title (as descriptive as possible, and if applicable, include location and runway number).					
21. Description: (a) Identification of problem, (b) proposed change, (c) Interface Impact, (d) cost, (e) benefits, (f) schedule, (g) justification of time critical/urgent.					
(attach additional sheets if necessary)					
22. Title of Originating Office Manager		Signature			Date

Case File Number					NCP Number			Page 2 of	
23. Facility/Sector Review (AT/AF)					24. Regional Review (AT/AF/FS/AS)				
Name	Routing Symbol	Date	Concur	Non-Concur	Name	Routing Symbol	Date	Concur	Non-Concur
<div style="display: flex; justify-content: space-between;"> <div> <input type="checkbox"/> RECOMMEND APPROVAL <small>(Enter into CMHF; Forward to Prescreening Office)</small> </div> <div> <input type="checkbox"/> DISAPPROVE <small>(Return to Originator)</small> </div> </div>									
Routing Symbol		Signature			Routing Symbol		Signature		
Date					Date				
Routing Symbol		Signature			Routing Symbol		Signature		
Date					Date				
23a. Comments:					24a. Comments				
(attach additional sheets if necessary)					(attach additional sheets if necessary)				
25. Prescreening Review APM-150/APM-160/ATR-100/ATR-200 or other Comments									
(attach additional sheets if necessary)									
Recommended Must Evaluators					<input type="checkbox"/> RECOMMEND APPROVAL <input type="checkbox"/> DISAPPROVE <small>(Return Original to Originating Office Send Information Copy to AES-410)</small>				
Name	Routing Symbol	Date	Concur	Non-Concur					
					<div style="display: flex;"> <div style="flex: 1;"> Routing Symbol Date </div> <div style="flex: 2;"> Signature </div> </div>				
26. FOR CONFIGURATION MANAGEMENT USE ONLY									